2. Subbasin Assessment – Water Quality Concerns and Status

Water quality in American Falls Subbasin has been affected by land use (EPA et al. 2000). Aquatic resources in the upper Snake River Plain, which includes American Falls Reservoir, Snake River, and adjacent areas, have been degraded by irrigation diversions, channelization, grazing, dams, sewage treatment, nonpoint pollution, food processing, and phosphate processing.

2.1 Water Quality Limited Segments Occurring in the Subbasin

There are ten water quality limited segments in American Falls Subbasin on the federal 303(d) list (DEQ 2000a). Sediment and nutrients are the predominant pollutant concerns in the subbasin (Table 2-1). Only Knox Creek was added in 1998; other waterbodies were carryovers from previous 303(d) lists.

The 1998 303(d) list shows dissolved oxygen, flow alteration, nutrients, and sediment affecting beneficial uses in American Falls Reservoir. Beneficial uses in the reservoir designated in Idaho Water Quality Standards (see Section 2.2) are coldwater aquatic life, primary contact recreation, and domestic water supply (DEQ nda). Secondary contact recreation is an existing beneficial use (see Section 2.2). All waterbodies are considered to have agriculture and industrial water supply, wildlife habitat, and aesthetics as beneficial uses (DEQ nda).

Snake River contains two water quality limited segments (Table 2-1). The lower segment from the reservoir to Ferry Butte has only sediment identified as a problem. From Ferry Butte to Bingham-Bonneville county line, dissolved oxygen, flow alteration, nutrients, and sediment are listed as problems. Designated beneficial uses as recognized in Idaho Water Quality Standards for this reach of Snake River are coldwater aquatic life, salmonid spawning, primary contact recreation, and domestic water supply. The Snake River also supports secondary contact recreation.

McTucker Creek has only sediment listed as a pollutant of concern. There are no designated beneficial uses in the water quality standards for McTucker Creek, but existing beneficial uses include coldwater aquatic life and secondary contact recreation.

Bannock Creek was listed on the 1998 303(d) list, along with four tributaries: Knox Creek, Moonshine Creek, Rattlesnake Creek, and West Fork Bannock Creek. The tributaries are listed from their headwaters to the Fort Hall Indian Reservation boundary. Designated beneficial uses for Bannock Creek are coldwater aquatic life and secondary contact recreation. Salmonid spawning is considered an existing use. Bannock Creek (HUC 17040206, segment 2349 Headwaters to Fort Hall Indian Reservation Boundary and segment 6351 Fort Hall Indian Reservation Boundary to American Falls) were listed as being impaired for bacteria, nutrients, and sediment. The four tributaries of Bannock Creek have existing beneficial uses of coldwater aquatic life and secondary contact recreation. Moonshine Creek (HUC 17040206 segment 6349), Rattlesnake Creek (HUC 17040206 segment 2350), and West Fork Bannock Creek (HUC 17040206 segment 6350) were listed as having sediment impairments.

Table 2-1. Water quality limited segments in American Falls Subbasin on the 303(d) list including listed pollutants and beneficial uses.

Waterbody	Tributary of	Water quality limited segment boundary		Stream length (miles)	Listed pollutants[1]	Beneficial uses[2]				
						Cold water aquatic life	Salmonid spawning	Contact recreation		Domestic water
		Lower	Upper					Primary	Secondary	
American Falls Reservoir					DO, Flow Alt, Nut, Sed	Yes		Yes	Yes	Yes
Snake River		American Falls Reservoir	Ferry Butte	14.94	Sed	Yes	Yes	Yes	Yes	Yes
		Ferry Butte	Bingham-Bonneville county line	40.44	DO, Flow Alt, Nut, Sed	Yes	Yes	Yes	Yes	Yes
McTucker Creek	Snake River	Snake River	Headwaters	2.19	Sed	Yes			Yes	
Bannock Creek	Snake River	American Falls Reservoir	Reservation boundary	30.31	Bact, Nut, Sed	Yes	Yes		Yes	
		Reservation boundary	Headwaters	21.12	Bact, Nut, Sed	Yes	Yes		Yes	
Moonshine Creek	Bannock Creek	Reservation boundary	Headwaters	1.35	Sed	Yes			Yes	
Rattlesnake Creek	Bannock Creek	Reservation boundary	Headwaters	14.53	Sed	Yes			Yes	
West Fork Bannock Creek	Bannock Creek	Reservation boundary	Headwaters	3.64	Sed	Yes			Yes	
Knox Creek	Bannock Creek	Bannock Creek	Headwaters	11.31	Unknown	Yes			Yes	

[1]DO=dissolved oxygen, Flow Alt=flow alteration, Nut=nutrients, Sed=sediment, Bact=bacteria

[2]beneficial use information from the Idaho Water Quality Standards and Wastewater Treatment Requirements and Beneficial Use Reconnaissance Program monitoring. All waterbodies are considered to support agriculture and industrial water supply, wildlife habitat, and aesthetics.

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Knox Creek (HUC 17040206 segment 5236) was added to the 1998 list as not supporting the coldwater aquatic life beneficial use for an unknown pollutant based upon the assessment completed through the BURP monitoring project.

2.2 Applicable Water Quality Standards

Several water quality standards apply to waterbodies in the American Falls Reservoir Subbasin, such that, when met, beneficial uses are supported. These standards take two forms – numeric and narrative. Numeric standards have a specific value (e.g., concentration, temperature, turbidity units) below or above which beneficial use support is impaired. Narrative standards do not have specific thresholds and may vary based on site-specificity. Such standards typically state that quantities of the pollutant should not exceed the point where beneficial uses are being impaired. Ultimately, the goal of water quality standards and a TMDL plan is to support beneficial uses in Idaho lakes and streams.

Some water quality numeric standards are more directly applicable to conditions in American Falls Subbasin. These include standards for dissolved oxygen, temperature, turbidity, and bacteria (Table 2-2). Standards also exist for other pollutants that are generally not a problem in American Falls Subbasin such as pH, toxic substances, and ammonia (Appendix A).

Beneficial Uses

Idaho water quality standards require that surface waters of the state be protected for beneficial uses wherever attainable (IDAPA 58.01.02.050.02). These beneficial uses are interpreted as existing uses, designated uses, and "presumed" uses as briefly described in the following paragraphs. The *Water Body Assessment Guidance*, second edition, (Grafe et al. 2002) details beneficial use identification for use assessment purposes.

Existing Uses

Existing uses under the CWA are "those uses actually attained in the waterbody on or after November 28, 1975, whether or not they are included in the water quality standards." The existing in-stream water uses and the level of water quality necessary to protect those uses shall be maintained and protected (IDAPA 58.01.02.003.35, .050.02, and 051.01 and .053). Existing uses include uses actually occurring, whether or not the level of quality to fully support the uses exists. Practical application of this concept would be when a waterbody could support salmonid spawning, but salmonid spawning is not yet occurring.

Designated Uses

Designated uses under the CWA are "those uses specified in water quality standards for each waterbody or segment, whether or not they are being attained." Designated uses are simply uses officially recognized by the state. In Idaho, examples include aquatic life support, recreation in and on the water, domestic water supply, and agricultural use.

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Table 2-2. State of Idaho water quality numeric standards (from Idaho Department of Environmental Quality Water Quality Standards and Wastewater Treatment Requirements nda). Max = maximum, avg = average, and min = minimum.

Beneficial use	Criteria			
	Dissolved oxygen[1]	Temperature	Turbidity[2]	*E. coli*
Cold Water Biota	>= 6.0 mg/l, instantaneous	<= 22°C, instantaneous; and, <= 19°C, max daily avg	<= 50 NTU, instantaneous; or, <= 25 NTU, for > 10 consecutive days	
Salmonid Spawning	1-day min >= the greater of 6.0 mg/l or 90% saturation	<= 13°C, instantaneous; and, <= 9°C, max daily avg		
Primary Contact Recreation				<= 406 organisms/100 ml, single sample; or, <= geometric mean of 126 organisms/100 ml in min of 5 samples taken every 3-5 days over 30-day period
Secondary Contact Recreation				<= 576 organisms/100 ml, single sample; or, <= geometric mean of 126 organisms/100 ml in min of 5 samples taken every 3-5 days over 30-day period
Domestic Water Supply			increase of <= 5 NTU, when background < 50 NTU; or increase of <= 10%, not to exceed 25 NTU when background > 50 NTU	

[1]criteria for streams only, criteria for lakes and reservoirs differ

[2]above background

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Water quality must be sufficiently maintained to meet the most sensitive use. Designated uses may be added or removed using specific procedures provided for in state law, but the effect must not be to preclude protection of an existing higher quality use such as coldwater aquatic life or salmonid spawning. Designated uses are specifically listed for waterbodies in Idaho in tables in the Idaho water quality standards (see IDAPA 58.01.02.003.22 and .100, and IDAPA 58.01.02.109-160 in addition to citations for existing uses.)

Presumed Uses

In Idaho, most waterbodies listed in the designated use tables in the water quality standards, along with all unlisted waterbodies, do not yet have specific use designations. These undesignated uses are to be designated. In the interim, and absent information on existing uses, DEQ presumes that most waters in the state will support coldwater aquatic life and either primary or secondary contact recreation (IDAPA 58.01.02.101.01). To protect these so-called "presumed uses," DEQ will apply the numeric criteria for coldwater aquatic life and primary or secondary contact recreation to undesignated waters. If, in addition to these presumed uses, there is an existing use, salmonid spawning for example, because of the requirement to protect levels of water quality for existing uses, numeric criteria for salmonid spawning would apply (e.g., intergravel dissolved oxygen, temperature). Conversely, if coldwater is not found to be an existing use, an appropriate use designation is needed before some other aquatic life criteria (such as seasonal cold) can be applied in lieu of coldwater criteria. (IDAPA 58.01.02.101.01).

2.3 Summary and Analysis of Existing Water Quality Data

The quantity of data varies by waterbody. More data exist for Snake River and American Falls Reservoir than for smaller waterbodies. Major monitoring on the river and reservoir has been done by BOR, DEQ, and USGS. Neil and Marita Poulson, working under contract for various entities, and BOR have gathered information on smaller waterbodies.

Flow Characteristics, Water Column and Biological Data, Other Data, Status of Beneficial Uses, Conclusions

American Falls Reservoir

Low and Mullins (1990) estimated total reservoir inflow at about 5.8 million ac-ft. Of this amount, 63% is from surface water runoff, 33% from groundwater discharge, and 4% from ungaged tributaries, canals, ditches, sloughs, and precipitation.

American Falls Reservoir can undergo substantial changes in storage volume on an annual basis. These fluctuations depend on water year and irrigation demands. For example, in WY2003, storage was at a high in the beginning of April at almost 1.4 million ac-ft (Figure 1-5). The average high occurs in late April at about 1.55 million ac-ft. In October of 2003, storage volume was down below 36,000 ac-ft compared to an average of about 520,000 ac-ft.

Heimer (1989) noted that annual water level fluctuations and poor water quality make for stressful conditions for game fish populations.
American Falls Reservoir has a history of heavy algal blooms associated with increased levels of nutrients. Based on phosphorus levels, the reservoir falls in the range of eutrophic (nutrient rich) waterbodies (Bushnell 1969). Bushnell (1969) noted in his review of the 1967 irrigation season that the Idaho Public Health Department reported " . . . a very heavy algal bloom occurred resulting in septic conditions in the reservoir and for some distance downstream causing offensive odors and extensive fish kills." Problems at the time with low dissolved oxygen levels were a result, in part, from chemical oxygen demand linked to municipal and industrial loadings. Input from such sources has been greatly diminished through the Clean Water Act and the NPDES program. Recreationists still, however, complain about the abundance of algae in late summer.

In addition to nutrient concerns, the reservoir has had considerable shoreline erosion problems (John Dooley, former Minidoka Project manager, personal communication, cited in Stene 1997). Bureau of Reclamation and land holders in American Falls laid miles of riprap, using basalt from the surrounding area, to control the erosion problem. BOR also worked with the Natural Resources Conservation Service (NRCS) Plant Materials Center at Aberdeen on vegetation to control shoreline erosion. Of the approximately 100 miles of shoreline around the reservoir, 85 miles have been identified as being in highly erodible soils (Alicia Lane Boyd, Bureau of Reclamation/Burley, personal communication). BOR has placed 15 miles of rock or other nonerodible material, and performed erosion control work on approximately 20 miles of shoreline. Another 18 miles of shoreline is scheduled to have erosion work done. The remaining 47 miles of shoreline would be considered highly erosive sediment, but not highly erodible sections, because the shoreline is flat rather than characterized by steep cliffs.

Sediment into the reservoir has decreased overall capacity (Alicia Lane Boyd, Bureau of Reclamation/Burley, personal communication). When originally built in 1926, reservoir volume was estimated at 1.7 million acre-feet. During reconstruction of the dam in 1976, volume was estimated at 1.67 million acre-feet. This change represents at decrease in volume of 30,000 acre-feet over 50 years, although the margin of error of the estimate probably exceeds the 30,000 acre-feet difference. This 1.8% reduction in storage volume over 50 years equates to a 3.5% decrease over 100 years, well below BOR's goal of less than 5% loss before a portion of storage volume is allocated to sediment. The annual loss rate is 0.04%.

Volume loss in American Falls Reservoir is much less than rates used to identify sedimentation concerns in other areas. An internet review identified Nebraska as having guidelines regarding sedimentation of lakes and reservoirs. Nebraska (NDEQ 2001) considers any lake or reservoir with less than 25% volume loss due to sedimentation in full support of aesthetics beneficial use. An annual long-term sedimentation rate greater than or equal to 0.75% is used by Nebraska to place reservoirs on the state's Water Quality Concerns list for sedimentation (NDEQ 2003).

Recent data for American Falls Reservoir have been collected by BOR and DEQ (Appendix B). BOR has sampled water quality and field parameters for five sampling events since 1995. DEQ began its sampling in 2001 and sampled up to four sites in the summer, depending on accessibility. The number of sampling events varied by year depending on boat access to the reservoir. The number of sites sampled during each sampling event also changed based on weather conditions

Unfortunately, the three years of DEQ sampling have been low water years. Based on the Palmer Drought Index, the Pocatello area has been in drought conditions since early fall of 1999. Generally, conditions in the area have been rated as severe to extreme (Tom Edwards, Air Quality Analyst, DEQ/Pocatello, personal communication).

Data from the two agencies were summarized based on agency, site, year, and parameter. Parameters of greatest interest are phosphorus, nitrogen, and chlorophyll *a*. All three parameters provide an estimate of nutrients in the system: phosphorus and nitrogen directly, and chlorophyll *a* indirectly as an indicator of algal growth.

Concentrations of total phosphorus and orthophosphorus exhibited different trends in American Falls Reservoir in 2001 to 2003. Orthophosphorus did not vary substantially between bottom and column samples (Table 2-3), but there was a general trend of decreasing levels from down-reservoir (i.e., dam) to up-reservoir (i.e., county boundary). The trend of decreasing orthophosphorus concentrations moving up-reservoir did not hold true for total phosphorus. The mid-reservoir sites, Fenstermaker and Little Hole Draw (Figure 2-1), were just as likely to show higher concentrations of total phosphorus. With one exception, overall differences between column and bottom total phosphorus was minimal (Table 2-3). The exception during 2001 at the dam site was caused by a high concentration – 2.14 mg/L – of total phosphorus in a bottom sample taken in July of 2001. This concentration was not consistent with data from other sites and dates during 2001, as it was almost ten times the next highest concentration of 0.22 mg/L measured the following week. BOR data showed a difference between column and bottom samples in three of their five years of sampling, with the greatest difference being 0.13 mg/L in 1997. Based on visual examination of the data, no discernable differences for either phosphorus parameter appear between these years.

The level of internal phosphorus recycling is unknown, but it appears to be occurring. Phosphorus is released from the sediment at zero to low dissolved oxygen (DO) conditions (Alaoui Mhamdi et al. 2003, Cusimano et al. 2002), which often occurs during stratification. The level of low DO at which point phosphorus releases is unclear, but Lock et al. (2003) found increased stability (less tendency to move from sediment to water column) of phosphate at concentrations of 1-2 mg/L of DO. DEQ sampling in the reservoir near the dam showed low DO concentrations corresponded with the highest concentrations of dissolved orthophosphorus in bottom samples from 2001 to 2003 (Appendix B). On the five days (12 and 19 July 01, 2 and 15 July 02, 23 July 03) where DO was less than 3 mg/L, orthophosphorus ranged from 0.107-0.208 mg/L (Table 2-4). For the other fifteen sampling events, orthophosphorus levels never exceeded 0.097 mg/L. The only other site with DO less than 3 mg/L was the county boundary site on 3 July 01. Low DO at this site on this date corresponded to a generally elevated level of orthophosphorus, but not out of line with sampling events on other dates (23 May 01, 28 May 03) with higher levels of DO. The reason for 1) lower than expected concentration of orthophosphorus at this site in July or 2) higher than expected concentrations of orthophosphorus on the two dates in May is unknown.

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Table 2-3. Phosphorus, chlorophyll *a*, and nitrogen data (from BOR and DEQ sampling in American Falls Reservoir).

Year	Sampling agency	Number of samples[1]	Sample site	Sample location	Orthophosphorus (mg/L)			Total phosphorus (mg/L)			Chlorophyll *a* (mg/L)			NO_3/NO_2 (mg/L)			NH_3 (mg/L)			TKN (mg/L)			TN (mg/L)[2]
					Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	
1995	BOR	1		Column	0.06			0.08			0.007			0.02			0.12			0.41			0.43
		1		Bottom	0.06			0.07						0.02			0.12			0.25			0.27
1997	BOR	1		Column	0.00			0.03			0.052			0.02			0.07			0.86			0.88
		1		Bottom	0.13			0.16						0.03			0.09			0.18			0.21
1998	BOR	1		Column	0.01			0.01			0.003			0.04			0.04			0.29			0.33
		1		Bottom	0.07			0.09						0.15			0.12			0.25			0.40
2000	BOR	1		Column	0.05			0.07			0.006			0.09			0.06			0.28			0.37
		1		Bottom	0.06			0.06						0.10			0.08			0.30			0.40
2001	DEQ	10, 8	Dam	Column	0.08	0.00	0.05	0.10	0.01	0.07	0.041	0.001	0.008	0.14	0.02	0.08	0.15	0.01	0.08	0.72	0.27	0.47	0.54
		10		Bottom	0.21	0.00	0.08	2.14	0.02	0.29				0.16	0.03	0.08	0.40	0.03	0.15	0.62	0.29	0.44	0.51
		1	Fenster-	Column	0.04			0.06			0.014			0.16	0.16	0.16	0.07	0.07	0.07	0.42	0.42	0.42	0.58
		1	maker	Bottom	0.05			0.06						0.14	0.14	0.14	0.08	0.08	0.08	0.35	0.35	0.35	0.49
		8, 6	Little Hole	Column	0.05	0.00	0.04	0.16	0.03	0.09	0.057	0.006	0.019	0.35	0.01	0.16	0.19	0.01	0.09	0.73	0.40	0.54	0.70
		8	Draw	Bottom	0.06	0.00	0.04	0.14	0.03	0.08				0.32	0.01	0.15	0.19	0.01	0.11	0.93	0.32	0.56	0.71
		8, 6	County	Column	0.03	0.01	0.02	0.11	0.03	0.07	0.033	0.006	0.016	0.41	0.01	0.17	0.21	0.01	0.09	0.76	0.32	0.52	0.68
		7	Boundary	Bottom	0.04	0.01	0.02	0.10	0.03	0.08				0.35	0.01	0.20	0.24	0.01	0.11	0.68	0.36	0.50	0.70
		4	All sites	Column			0.04			0.07			0.014			0.14			0.08			0.49	0.63
2002	DEQ	5	Dam	Column	0.12	0.01	0.05	0.16	0.03	0.10	0.027	0.006	0.011	0.06	0.01	0.03	0.39	0.01	0.16	0.78	0.26	0.55	0.59
		5		Bottom	0.15	0.01	0.08	0.19	0.04	0.10				0.20	0.02	0.06	0.43	0.01	0.14	0.63	0.34	0.47	0.53
		3	Fenster-	Column	0.05	0.00	0.03	0.08	0.03	0.06	0.018	0.005	0.010	0.06	0.01	0.03	0.07	0.01	0.04	0.48	0.30	0.39	0.41
		3	maker	Bottom	0.05	0.03	0.04	0.14	0.05	0.09				0.20	0.02	0.08	0.37	0.01	0.21	0.72	0.27	0.46	0.54
		4	Little Hole	Column	0.09	0.02	0.05	0.15	0.04	0.08	0.018	0.003	0.013	0.36	0.03	0.13	0.17	0.01	0.08	0.76	0.40	0.52	0.65
		4	Draw	Bottom	0.09	0.03	0.05	0.14	0.05	0.09				0.33	0.01	0.10	0.18	0.01	0.09	0.82	0.42	0.54	0.64
		4	County	Column	0.05	0.01	0.02	0.12	0.04	0.08	0.042	0.011	0.023	0.37	0.01	0.13	0.08	0.01	0.04	0.70	0.41	0.62	0.75
		3	Boundary	Bottom	0.02	0.01	0.02	0.11	0.05	0.07				0.11	0.03	0.06	0.06	0.01	0.03	0.92	0.42	0.64	0.70
		4	All sites	Column			0.04			0.08			0.014			0.08			0.08			0.52	0.60
2003	BOR	1		Column	0.05			0.08			0.006			0.07			0.05			0.43			0.50
		1		Bottom	0.09			0.11						0.10			0.19			0.51			0.61
	DEQ	6	Dam	Column	0.10	0.01	0.05	0.17	0.03	0.09	0.031	0.004	0.011	0.06	0.01	0.04	0.13	0.01	0.07	0.83	0.26	0.49	0.52
		6		Bottom	0.13	0.01	0.06	0.16	0.03	0.09				0.07	0.01	0.05	0.21	0.01	0.11	0.71	0.28	0.47	0.52
		3	Fenster-	Column	0.06	0.05	0.05	0.15	0.10	0.12	0.069	0.004	0.032	0.07	0.01	0.03	0.17	0.02	0.07	1.27	0.65	0.87	0.91
		3	maker	Bottom	0.08	0.05	0.06	0.16	0.10	0.13				0.07	0.03	0.05	0.18	0.03	0.09	1.04	0.44	0.70	0.74
		5	Little Hole	Column	0.05	0.00	0.03	0.10	0.04	0.08	0.033	0.002	0.010	0.13	0.03	0.07	0.15	0.02	0.10	0.58	0.45	0.50	0.58
		4	Draw	Bottom	0.05	0.04	0.04	0.09	0.06	0.07				0.14	0.03	0.07	0.19	0.07	0.14	0.70	0.47	0.56	0.63
		4	County	Column	0.02	0.00	0.01	0.07	0.04	0.06	0.023	0.006	0.014	0.13	0.04	0.09	0.07	0.02	0.04	0.49	0.32	0.43	0.51
		3	Boundary	Bottom	0.04	0.01	0.02	0.08	0.05	0.07				0.08	0.06	0.07	0.10	0.02	0.06	0.53	0.44	0.49	0.57
		4	All sites	Column			0.04			0.08			0.017			0.06			0.07			0.57	0.63

[1]lower number represents number of chlorophyll *a* samples

[2]calculated by adding nitrate+nitrite concentration to total Kjeldahl nitrogen concentration (maximum values for BOR data, mean values for DEQ data)

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Figure 2-1. DEQ sample sites on American Falls Reservoir. Sites were located on the pictured transects close to the western shore.

Table 2-4. DEQ dissolved oxygen and orthophosphorus (bottom sampling) data from American Falls Reservoir, May 2001 to August 2003.

		Dam			Fenstermaker Point			Little Hole Draw Point			County Boundary Point		
Date	Sampling condition[1]	Depth (m)	DO (mg/L)	Dissolved ortho P (mg/L)	Depth (m)	DO (mg/L)	Dissolved ortho P (mg/L)	Depth (m)	DO (mg/L)	Dissolved ortho P (mg/L)	Depth (m)	DO (mg/L)	Dissolved ortho P (mg/L)
11-May-01	2nd deepest FP meas.	18	9.86					10	10.22		7	11.37	
	Deepest FP meas.	19	9.87					11	10.12		8	11.6	
	Bottom sample	19		0.007				11		< 0.003	8		0.005
	Reservoir bottom	20						12			8.9		
23-May-01	2nd deepest FP meas.	17	7.98					10	5.45		6	6.33	
	Deepest FP meas.	18	8.01					11	5.51		7	6.42	
	Bottom sample	18		< 0.003				11		0.036	7		0.044
	Reservoir bottom	19						12			8		
6-Jun-01	2nd deepest FP meas.	15	6.47								5	6.68	
	Deepest FP meas.	16	6.39								6	5.77	
	Bottom sample	16		0.055							none		
	Reservoir bottom	17									6.6		
20-Jun-01	2nd deepest FP meas.	14	5.31					8	5.96		6	5.57	
	Deepest FP meas.	15	5.32					9	6		7	5.5	
	Bottom sample	15		0.051				8.5		0.02	7		0.017
	Reservoir bottom	16						9.4			7.8		
3-Jul-01	2nd deepest FP meas.	13	4.91					6	5.39		5	4.25	
	Deepest FP meas.	14	5.04					7	4.27		6	2.87	
	Bottom sample	13		0.049				6.5		0.058	5		0.036
	Reservoir bottom	14						7.3			6.1		
12-Jul-01	2nd deepest FP meas.	11	2.6					4	5.55		1	6.93	
	Deepest FP meas.	12	1.97					5	5.58		2	6.9	
	Bottom sample	12		0.184				5.3		0.053	2.5		0.016
	Reservoir bottom	13						6.4			3		
19-Jul-01	2nd deepest FP meas.	11	3.67										
	Deepest FP meas.	12	2.37										
	Bottom sample	12		0.208									
	Reservoir bottom	13											
25-Jul-01	2nd deepest FP meas.	10	5.7					4	5.92		2	7.49	
	Deepest FP meas.	11	5.67					5	5.56		3	7.41	
	Bottom sample	11		0.083				5		0.048	3		0.015
	Reservoir bottom	12						5.6			3.9		
2-Aug-01	2nd deepest FP meas.	9	7.79					3	6.45		1	7.14	
	Deepest FP meas.	10	7.78					4	4.32		2	7.14	
	Bottom sample	10		0.058				3.5		0.042	2.2		0.011
	Reservoir bottom	11						4.2			2.6		
8-Aug-01	2nd deepest FP meas.	8	5.46		4	7.61		2	6.89				
	Deepest FP meas.	9	5.45		5	7.23		3	3.91				
	Bottom sample	9		0.095	5		0.046	3		0.06			
	Reservoir bottom	10			6			3.4					
4-Jun-02	2nd deepest FP meas.	15	9.44		12	8.65		8	7.3		5	9.21	
	Deepest FP meas.	16	9.16		13	7.49		9	7.33		6	9.2	
	Bottom sample	16		0.014	13		0.03	9		0.038	6		0.013
	Reservoir bottom	17			14			10			6.9		
20-Jun-02	2nd deepest FP meas.	14	8.12					7	9.76		6	10.87	
	Deepest FP meas.	15	8.01					8	9.54		7	10.65	
	Bottom sample	15		0.039				8.5		0.029	7		0.016
	Reservoir bottom	16						9.5			7.5		
2-Jul-02	2nd deepest FP meas.	12	1.83		10	8.08		7	8.09		5	7.4	
	Deepest FP meas.	13	1.81		11	8.06		8	8.1		6	7.4	
	Bottom sample	13		0.153	11		0.04	8		0.034	6		0.02
	Reservoir bottom	14			12			8.5			6.5		
15-Jul-02	2nd deepest FP meas.	10	2		8	7.02		4	6.69		3	6.9	
	Deepest FP meas.	11	1.75		9	5.01		5	6.76		4	6.84	
	Bottom sample	11		0.107	9		0.05	5		0.086	none		
	Reservoir bottom	12			10			5.9			4.3		
31-Jul-02	2nd deepest FP meas.	8	6.02										
	Deepest FP meas.	9	5.98										
	Bottom sample	9		0.076									
	Reservoir bottom	10											
28-May-03	2nd deepest FP meas.	15	8.41					9	6.71		7	8.35	
	Deepest FP meas.	16	8.28					10	4.11		8	8.24	
	Bottom sample	16		0.009				9		0.038	8		0.043
	Reservoir bottom	17						10			8.5		
9-Jun-03[2]	2nd deepest FP meas.	14	7.74					7	6.53		6	7.96	
	Deepest FP meas.	15	7.73					8	6.43		7	7.89	
	Bottom sample	15		0.035				8.5		0.04	6.5		0.018
	Reservoir bottom	16						9			7.5		
26-Jun-03	2nd deepest FP meas.	12	6.68		9	6.62		6	6.31		4	9.85	
	Deepest FP meas.	13	6.66		10	6.61		7	4.26		5	9.58	
	Bottom sample	13		0.061	10		0.061	6		0.051	5		0.005
	Reservoir bottom	14			11			7.2			5.7		
23-Jul-03	2nd deepest FP meas.	8	3.37		6	6.66		2	7.37				
	Deepest FP meas.	9	2.67		7	5.27		3	7.29				
	Bottom sample	9		0.129	7		0.082	3		0.05			
	Reservoir bottom	10			7.5			3.6					
5-Aug-03	2nd deepest FP meas.	6	7.39		3	7.47		1	8.56				
	Deepest FP meas.	7	7.52		4	7.91		2	8.64				
	Bottom sample	7.5		0.097	5		0.049	none					
	Reservoir bottom	8			5.1			2.2					

[1]FP=field parameter, meas.=measurement

[2]recalibrated barometric pressure, difference was approximately 5 mm (sonde was reading about 5 mm high)

Nitrogen varied within the reservoir and within years based on the species (Table 2-3). Nitrate-nitrite was higher at the two up reservoir sites compared to the two down reservoir sites. Over three years of DEQ sampling, ammonia was highest at the dam. Except for Fenstermaker Point, total Kjeldahl nitrogen (TKN) was generally consistent at the other three sites. In 2001 and 2002, the lowest concentrations of TKN were observed at Fenstermaker Point while the highest concentrations were collected there in 2003. Differences between column and bottom samples did not exhibit any trend for nitrate+nitrite or TKN, but bottom samples showed consistently higher concentrations of ammonia than column samples. Over the three-year period, except for nitrate+nitrite in 2000, averages were relatively consistent.

Levels of chlorophyll *a* ranged from less than 0.001 mg/L to almost 0.070 mg/L (Table 2-3). Average chlorophyll by site by year ranged from 0.0085 to 0.0323 mg/L. There appeared to be no trend within years among sites or over time (Figures 2-2, 2-3, and 2-4).

Data (Appendix B) collected by DEQ in 2001 showed two general trends in the phytoplankton community. First, phytoplankton species richness (number of species present), diversity, and evenness (a measure of how evenly each species is represented) peaked in July with both June and August numbers less than those seen in July (Table 2-5). A slightly different trend was observed at the county boundary site where the phytoplankton community remained at similar levels at the end of July through the beginning of August. Second, overall richness and diversity, but not evenness, increased up-reservoir from the dam to the county boundary. The diatom community showed similar trends (Table 2-6).

Phosphorus was elevated over suggested thresholds for lakes and reservoirs. EPA (1986) recommended total phosphorus not exceed 0.025 mg/L in their 1986 Water Quality Criteria guidance. BOR and DEQ data show concentrations consistently up to double that level. In 2000, EPA published Ambient Water Quality Criteria Recommendations in Nutrient Ecoregion III (Xeric West) for both rivers and streams, and lakes and reservoirs (referred to as EPA [2000] Criteria for this report). They reported aggregate reference conditions for total phosphorus in lakes and reservoirs to be 0.017 mg/L.

Levels of total nitrogen in American Falls Reservoir fell within the range of concentrations reported for reference conditions in Xeric West lakes and reservoirs. EPA (2000) Criteria found total nitrogen ranging from 0.15 to 1.44 mg/L for lakes and reservoirs based on the 25^{th} percentile of waterbodies examined. Annual average total nitrogen concentrations in American Falls Reservoir were 0.6 mg/L in 2002 and 0.63 mg/L in 2001 and 2003 (Table 2-3).

Typically, phosphorus is the limiting nutrient in freshwater ecosystems (NRCS 1999). Nitrogen is usually considered to be limiting when the nitrogen to phosphorus ratio is less than 10:1 (UNEP Web site). When the ratio exceeds 20:1, phosphorus is considered limiting. The ratio of total nitrogen to phosphorus never exceeded 15:1 in the summers of 2001-2003 (Table 2-7). Except at the County Boundary site, the ratio of bioavailable nitrogen (total inorganic nitrogen) to phosphorus (orthophosphorus) commonly was below 10:1. Generally, high (greater than 0.020 mg/L) chlorophyll *a* levels corresponded to lower total inorganic nitrogen to orthophosphorus ratios. These average N:P ratios, compared to general “rules of thumb” about nutrient limitation, suggest that nitrogen could be limiting phytoplankton growth in

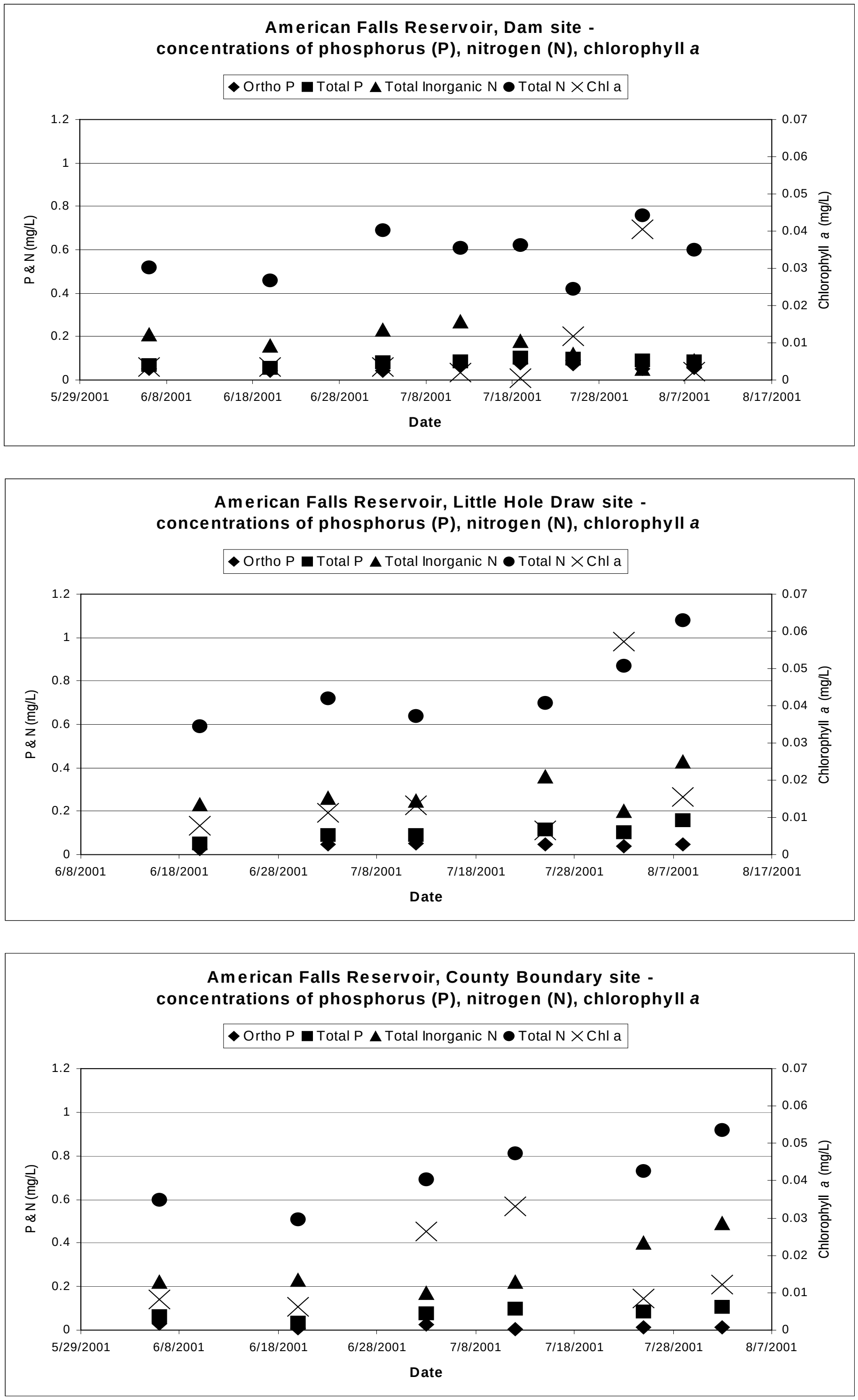
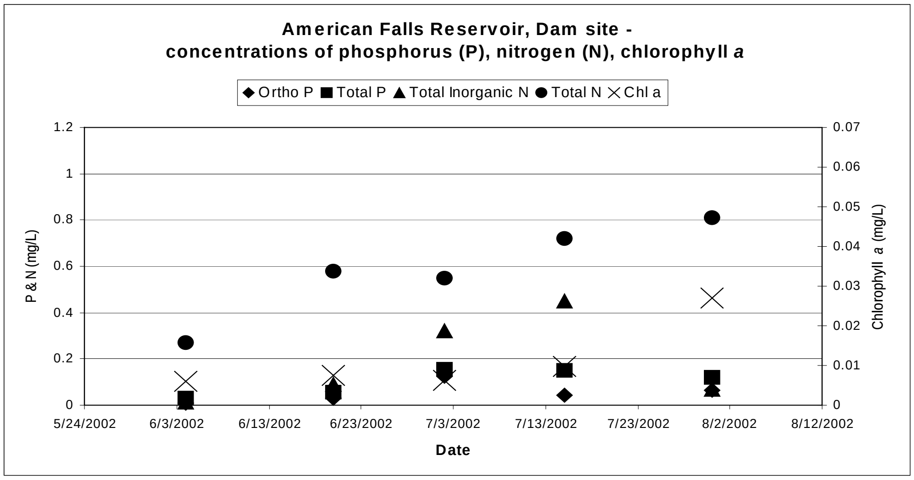
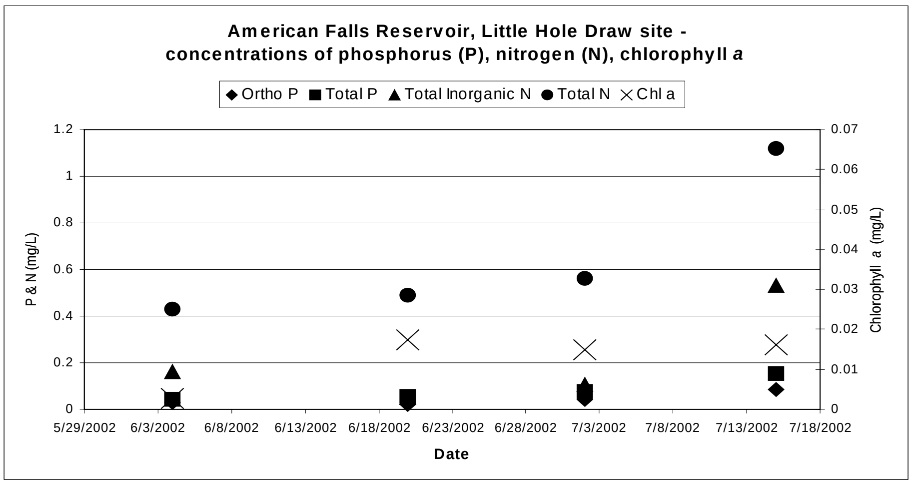


Figure 2-2. Phosphorus, nitrogen, and chlorophyll *a* levels at three sites in American Falls Reservoir, 2001.





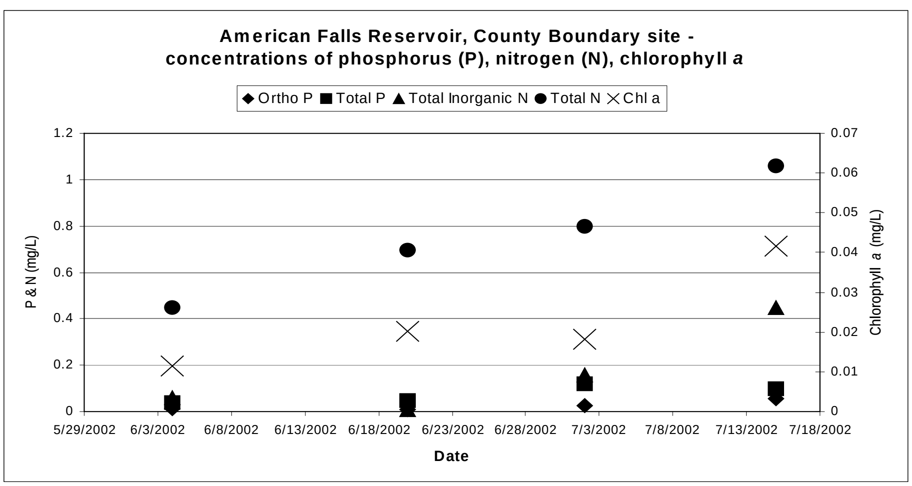


Figure 2-3. Phosphorus, nitrogen, and chlorophyll *a* levels at three sites in American Falls Reservoir, 2002.

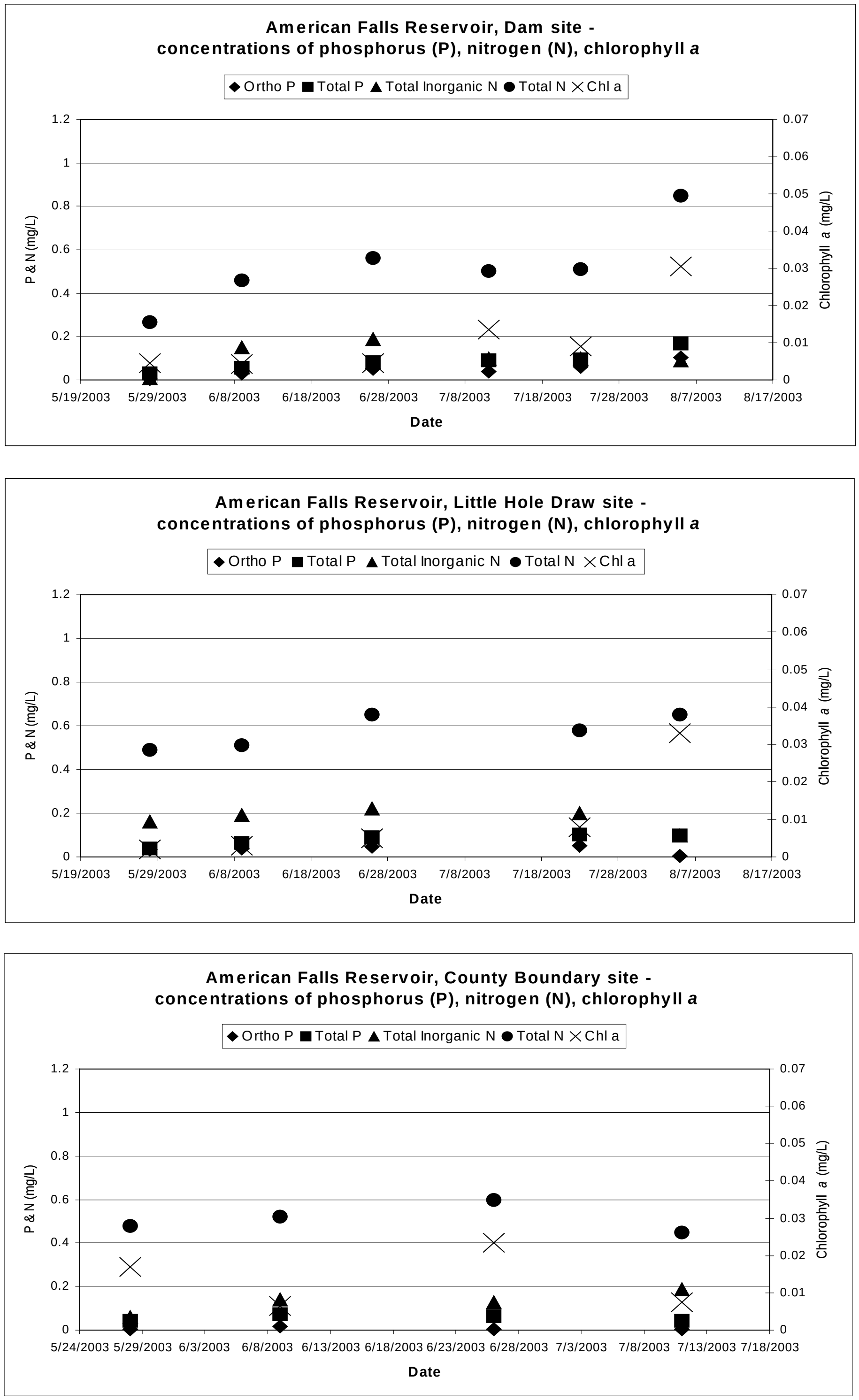


Figure 2-4. Phosphorus, nitrogen, and chlorophyll *a* levels at three sites in American Falls Reservoir, 2003.

Table 2-5. Indices from phytoplankton sampling by DEQ in American Falls Reservoir in 2001.

Site	Date	Richness	Maximum diversity	Shannon Diversity - standard algal concentration	Shannon Diversity - standard algal cell concentration	Shannon Diversity - small sample algal concentration	Shannon Diversity - small sample algal cell concentration	McIntosh u - algal concentration	McIntosh u - algal cell concentration	Evenness (based Shannon standard algal concentration)	Evenness (based Shannon standard algal cell concentration)	Evenness (based Shannon small sample algal concentration)	Evenness (based Shannon small sample algal cell concentration)
Dam	6-Jun-01	14	2.6391	1.5047	1.5357	1.4325	1.4649	58891	58907	0.5702	0.5819	0.4299	0.4396
Dam	20-Jun-01	18	2.8904	1.1449	1.2539	1.1305	1.24	3111250	3112877	0.3961	0.4338	0.3155	0.346
Dam	3-Jul-01	21	3.0445	1.6314	1.874	1.5912	1.8467	292977	471763	0.5359	0.6155	0.4257	0.4941
Dam	12-Jul-01	31	3.434	1.9064	2.4672	1.8126	2.411	156800	202152	0.5552	0.7185	0.4392	0.5842
Dam	19-Jul-01	24	3.1781	1.9828	1.8631	1.8925	1.8314	60512	655097	0.6239	0.5863	0.4889	0.4731
Dam	25-Jul-01	18	2.8904	1.4872	0.2778	1.4558	0.2763	473829	543428981	0.5145	0.0961	0.4063	0.0771
Dam	2-Aug-01	15	2.7081	1.0857	0.127	1.0812	0.1269	21488207	26910743298	0.4009	0.0469	0.3179	0.0373
Dam	8-Aug-01	19	2.9444	1.7343	0.9247	1.6608	0.9112	83011	5572392	0.589	0.314	0.4566	0.2505
Fenstermaker	8-Aug-01	30	3.4012	1.9455	1.4749	1.9327	1.4706	5410016	78641212	0.572	0.4336	0.472	0.3592
Little Hole Draw	20-Jun-01	20	2.9957	1.2949	1.5887	1.2848	1.5811	6913658	8456516	0.4323	0.5303	0.3483	0.4286
Little Hole Draw	3-Jul-01	29	3.3673	1.7331	2.21	1.7009	2.1925	1095781	1794733	0.5147	0.6563	0.4189	0.54
Little Hole Draw	12-Jul-01	25	3.2189	1.7896	0.998	1.7376	0.9912	233554	33148034	0.556	0.3101	0.4442	0.2534
Little Hole Draw	25-Jul-01	45	3.8067	1.7537	2.2504	1.7379	2.2383	11753288	12350907	0.4607	0.5912	0.3862	0.4974
Little Hole Draw	2-Aug-01	10	2.3026	0.6817	0.1083	0.6661	0.1078	1064512	1385059860	0.296	0.047	0.2224	0.036
Little Hole Draw	8-Aug-01	8	2.0794	0.6171	0.0886	0.6123	0.0884	6623329	9452473495	0.2968	0.0426	0.2208	0.0319
County Boundary	6-Jun-01	17	2.8332	1.8791	0.7893	1.7284	0.7799	12376	8417688	0.6632	0.2786	0.4901	0.2212
County Boundary	20-Jun-01	29	3.3673	1.6128	1.7503	1.6097	1.7475	115861760	116847941	0.4789	0.5198	0.3964	0.4304
County Boundary	3-Jul-01	21	3.0445	1.7729	1.9416	1.7697	1.9392	37035703	55271802	0.5823	0.6377	0.4735	0.5188
County Boundary	12-Jul-01	39	3.6636	2.0059	2.3432	2.0011	2.3392	59673984	62982444	0.5475	0.6396	0.4593	0.5369
County Boundary	25-Jul-01	37	3.6109	1.9078	2.1875	1.8998	2.1803	20494377	20748075	0.5284	0.6058	0.4414	0.5066
County Boundary	2-Aug-01	37	3.6109	2.1191	2.442	2.0934	2.4271	1735036	3396277	0.5869	0.6763	0.4864	0.5639

Table 2-5. Continued.

Site	Date	Variation (based Shannon standard algal concentration)	Variation (based Shannon standard algal cell concentration)	Berger Parker - algal concentration	Berger Parker - algal cell concentration	Margalef diversity algal concentration	Margalef diversity algal cell concentration	Simpson diversity algal concentration	Simpson diversity algal cell concentration	Evenness (based Simpsons diversity algal concentration)	Evenness (based Simpsons diversity algal cell concentration)	Palmer Water Quality Index (based on algae)	Alpha algal concentration	Alpha algal cell concentration
Dam	6-Jun-01	3.8974	4.0334	1.6818	1.6958	2.1751	2.172	2.6386	2.6821	0.1885	0.1916	4	2.8323	2.8264
Dam	20-Jun-01	3.1062	3.5756	1.4406	1.478	2.1754	2.1683	1.9708	2.0734	0.1095	0.1152	4	2.628	2.6165
Dam	3-Jul-01	3.8669	4.56	2.8703	3.6465	2.8729	2.7267	3.8007	4.9807	0.181	0.2372	8	3.7151	3.442
Dam	12-Jul-01	5.1345	7.0054	2.4851	3.941	4.4696	4.1823	4.312	8.411	0.1391	0.2713	3	6.3673	5.702
Dam	19-Jul-01	4.9238	4.9739	3.0598	2.13	3.6234	3.1203	5.3899	3.8562	0.2246	0.1607	3	5.0709	4.0102
Dam	25-Jul-01	3.8581	1.2609	1.7261	1.0472	2.4183	1.6827	2.6942	1.0962	0.1497	0.0609	0	3.0402	1.9029
Dam	2-Aug-01	2.8114	0.675	1.4441	1.0184	1.5953	1.1641	1.9513	1.0371	0.1301	0.0691	9	1.8364	1.2728
Dam	8-Aug-01	4.1165	2.681	2.2311	1.2845	2.8383	2.2478	3.8845	1.6195	0.2044	0.0852	9	3.7872	2.7097
Fenstermaker	8-Aug-01	5.6562	4.562	2.2343	1.5977	3.4363	3.0454	3.9542	2.3738	0.1318	0.0791	15	4.2965	3.6456
Little Hole Draw	20-Jun-01	3.771	4.1471	1.5201	2.0433	2.3012	2.2216	2.1475	3.1724	0.1074	0.1586	0	2.7619	2.6374
Little Hole Draw	3-Jul-01	5.0097	6.173	1.8752	3.3794	3.7232	3.4528	3.1081	6.163	0.1072	0.2125	6	4.8846	4.3701
Little Hole Draw	12-Jul-01	4.3825	3.0078	2.4345	1.3053	3.4787	2.6919	4.2084	1.6732	0.1683	0.0669	6	4.66	3.2283
Little Hole Draw	25-Jul-01	5.2488	7.1124	1.957	2.4771	5.0441	4.9114	3.2107	4.8954	0.0713	0.1088	22	6.5787	6.3245
Little Hole Draw	2-Aug-01	1.8345	0.5415	1.1984	1.0164	1.2651	0.8538	1.4194	1.0329	0.1419	0.1033	0	1.4887	0.9435
Little Hole Draw	8-Aug-01	1.3009	0.4045	1.2398	1.0144	0.8698	0.6087	1.4764	1.0288	0.1846	0.1286	9	0.9932	0.6725
County Boundary	6-Jun-01	4.7251	2.0969	2.5373	1.2736	2.9339	1.9517	4.4088	1.5683	0.2593	0.0923	5	4.2156	2.3093
County Boundary	20-Jun-01	4.479	4.9684	1.9237	2.0341	2.8453	2.8292	3.0465	3.3775	0.1051	0.1165	12	3.3608	3.3364
County Boundary	3-Jul-01	4.1857	4.6774	3.1077	4.0829	2.1136	2.0483	4.4698	5.4791	0.2128	0.2609	10	2.4516	2.3578
County Boundary	12-Jul-01	5.9995	7.357	2.6144	3.1175	3.9219	3.8519	4.3666	5.8829	0.112	0.1508	16	4.8028	4.6871
County Boundary	25-Jul-01	5.3463	6.6287	2.4642	2.7315	3.9405	3.8966	4.2042	5.1024	0.1136	0.1379	21	4.9029	4.8271
County Boundary	2-Aug-01	6.25	7.3743	2.5019	4.042	4.5181	4.2324	4.8029	7.194	0.1298	0.1944	22	5.9866	5.4292

Table 2-6. Indices from phytoplankton (diatoms only) sampling by DEQ in American Falls Reservoir in 2001.

Site	Date	Diatom richness	Maximum diversity	Shannon Diversity - standard algal concentration	Shannon Diversity - standard algal cell concentration	Shannon Diversity - small sample algal concentration	Shannon Diversity - small sample algal cell concentration	McIntosh u - algal concentration	McIntosh u - algal cell concentration	Evenness (based Shannon standard algal concentration)	Evenness (based Shannon standard algal cell concentration)	Evenness (based Shannon small sample algal concentration)	Evenness (based Shannon small sample algal cell concentration)
Dam	6-Jun-01	3	1.0986	0.1054	0.1047	-61.4569	-62.4719	76	76	0.0959	0.0953	-34.2997	-34.8662
Dam	20-Jun-01	2	0.6931	0.1039	0.1019	0.0287	0.0254	2818	2818	0.1499	0.147	0.0207	0.0184
Dam	3-Jul-01	4	1.3863	0.0974	0.1071	-12.6795	-1.3739	136	429	0.0702	0.0772	-6.0975	-0.6607
Dam	12-Jul-01	10	2.3026	0.0967	0.3072	-1512.4542	-3.3045	116	18282	0.042	0.1334	-504.8696	-1.1031
Dam	19-Jul-01	6	1.7918	0.4034	0.2779	-0.0394	-0.6575	4899	5605	0.2252	0.1551	-0.0158	-0.2646
Dam	25-Jul-01	4	1.3863	0.2114	0.0312	-0.038	-2.2035	4631	6306	0.1525	0.0225	-0.0183	-1.0596
Dam	2-Aug-01	1	0	0.174	0.0147	0.1715	0.0118	165835	165835	0	0	0.2474	0.017
Dam	8-Aug-01	2	0.6931	0.3588	0.1149	0.3228	0.0724	4894	4894	0.5176	0.1657	0.2329	0.0523
Fenstermaker	8-Aug-01	8	2.0794	0.6453	0.4834	0.6389	0.4776	4334109	4462486	0.3103	0.2325	0.2304	0.1722
Little Hole Draw	20-Jun-01	7	1.9459	0.2585	0.2508	0.1835	0.1906	17315	21048	0.1329	0.1289	0.0695	0.0722
Little Hole Draw	3-Jul-01	9	2.1972	0.4547	0.741	0.2356	0.7211	15333	543418	0.207	0.3373	0.0815	0.2495
Little Hole Draw	12-Jul-01	5	1.6094	0.1582	0.0367	-5.7856	-211.8131	1172	1251	0.0983	0.0228	-2.5126	-91.9893
Little Hole Draw	25-Jul-01	13	2.5649	0.8343	0.9058	0.8272	0.899	10071244	10115447	0.3253	0.3531	0.2539	0.2759
Little Hole Draw	2-Aug-01	0	0	0	0	0	0	0	0	0	0	0	0
Little Hole Draw	8-Aug-01	2	0.6931	0.0982	0.0055	0.0462	-4.6439	2303	2303	0.1416	0.0079	0.0333	-3.3499
County Boundary	6-Jun-01	7	1.9459	0.5293	0.0731	-0.3252	-44.444	456	499	0.272	0.0376	-0.1232	-16.8409
County Boundary	20-Jun-01	14	2.6391	0.6307	0.7611	0.6255	0.7568	16257837	17234495	0.239	0.2884	0.1877	0.2271
County Boundary	3-Jul-01	11	2.3979	0.6206	0.6008	0.6157	0.5961	13185170	13256190	0.2588	0.2505	0.1992	0.1929
County Boundary	12-Jul-01	14	2.6391	0.8939	0.9158	0.8906	0.9127	38838924	39043054	0.3387	0.347	0.2673	0.2739
County Boundary	25-Jul-01	13	2.5649	0.7619	0.8006	0.7562	0.7952	14730959	14750215	0.297	0.3121	0.2321	0.2441
County Boundary	2-Aug-01	25	3.2189	1.5758	1.3063	1.5539	1.2859	1549197	1575384	0.4896	0.4058	0.3972	0.3287

Table 2-6. Continued.

Site	Date	Variation (based Shannon standard algal cell concentration)	Berger Parker - algal concentration	Berger Parker - algal cell concentration	Margalef Diversity algal concentration	Margalef Diversity algal cell concentration	Simpson Diversity algal concentration	Simpson Diversity algal cell concentration	Evenness (based Simpsons Diversity algal concentration)	Evenness (based Simpsons Diversity algal cell concentration)	Palmer Water Quality Index (based on algae)	Pollution tolerance algal concentration	Pollution tolerance algal cell concentration	Relative abundance achnanthes minutissima algal concentration
Dam	6-Jun-01	0.4444	1.1515	1.1515	0.8687	0.8687	2038.5682	2072.7158	679.5227	690.9053	4	0.3289	0.3289	0
Dam	20-Jun-01	0.432	1.1964	1.1964	0.242	0.242	2176.1703	2290.6475	1088.0851	1145.3238	0	3	3	0
Dam	3-Jul-01	0.5393	2.375	1.8	1.002	0.8572	8197.0398	5479.7826	2049.2599	1369.9457	3	2.8421	2.9048	0
Dam	12-Jul-01	0.9565	1.46	1.125	3.2959	1.7923	5834.8508	93.0023	583.4851	9.3002	3	2.7671	2.8988	0
Dam	19-Jul-01	1.0904	1.3119	1.7393	1.1138	1.048	66.5699	450.679	11.095	75.1132	3	2.233	2.4215	0
Dam	25-Jul-01	0.1992	1.118	1.7816	0.693	0.6256	275.686	94461.6083	68.9215	23615.4021	0	2.0528	2.4056	0
Dam	2-Aug-01	0.0882	1	1	0	0	252.8349	168296.5129	252.8349	168296.5129	0	2	2	0
Dam	8-Aug-01	0.4757	1.25	1.25	0.2252	0.2252	65.8812	1843.8167	32.9406	921.9083	0	2.2	2.2	0
Fenstermaker	8-Aug-01	1.3968	1.1691	1.3145	0.8984	0.8851	4.9357	41.8321	0.617	5.229	6	2.0161	2.125	0
Little Hole Draw	20-Jun-01	1.1359	2.2839	2.8169	1.0965	1.056	857.4751	1274.6059	122.4964	182.0866	0	2.7912	2.8307	0
Little Hole Draw	3-Jul-01	1.9217	2.5002	1.7367	1.4636	1.1381	222.1231	20.3544	24.6803	2.2616	3	2.7071	2.9387	0
Little Hole Draw	12-Jul-01	0.2195	1.2065	1.3716	1.0775	1.0415	838.4611	44342.2681	167.6922	8868.4536	3	2.0856	2.1957	0
Little Hole Draw	25-Jul-01	2.4193	1.2765	1.3606	1.4465	1.4355	3.7469	5.9773	0.2882	0.4598	7	2.0687	2.1263	0
Little Hole Draw	2-Aug-01	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Hole Draw	8-Aug-01	0.0437	2	2	0.2371	0.2371	4245.7032	4222310.584	2122.8516	2111155.292	0	2.5	2.5	0
County Boundary	6-Jun-01	0.4401	2.2272	2.5681	1.6416	1.58	119.5214	26439.0231	17.0745	3777.0033	4	1.602	1.7876	0
County Boundary	20-Jun-01	2.3238	1.3357	1.5861	1.5164	1.4866	21.7111	22.8993	1.5508	1.6357	8	2.1445	2.2796	0
County Boundary	3-Jul-01	1.772	1.2249	1.3033	1.1918	1.183	12.5552	22.8453	1.1414	2.0768	7	1.9358	1.913	0
County Boundary	12-Jul-01	2.7388	1.339	1.4173	1.4412	1.4322	6.709	9.49	0.4792	0.6779	8	2.0391	2.0761	0
County Boundary	25-Jul-01	2.0312	1.297	1.3368	1.4128	1.4077	5.849	7.1772	0.4499	0.5521	9	2.096	2.1167	0.00365595
County Boundary	2-Aug-01	4.293	1.973	2.1376	3.1046	3.0728	5.3791	15.5091	0.2152	0.6204	8	2.0479	1.8987	0.09404574

Table 2-6. Continued.

Site	Date	Relative abundance achnanthes minutissima algal cell concentration	Siltation standard algal concentration	Siltation standard algal cell concentration	Siltation inclusive algal concentration	Siltation inclusive algal cell concentration	RA sensitive algal concentration	RA sensitive algal cell concentration	Generic acc cmn algal concentration	Generic acc cmn algal cell concentration	Centrales Pennales algal concentration	Centrales Pennales algal cell concentration	Alpha algal concentration	Alpha algal cell concentration
Dam	6-Jun-01	0	0.02369033	0.02349438	0.02369033	0.02349438	0.00166819	0.0016544	0.0758	0.0758	0	0	1.4535	1.4535
Dam	20-Jun-01	0	0	0	0	0	0.02516555	0.02452865	0	0	0.8359	0.8359	0.3946	0.3946
Dam	3-Jul-01	0	0	0	0	0	0.01593448	0.01953923	0	0	0	0	1.5049	1.1902
Dam	12-Jul-01	0	0.00051126	0.0003224	0.00051126	0.0003224	0.01687064	0.1121474	0	0	0.0274	0.0028	12.4563	2.4038
Dam	19-Jul-01	0	0	0	0	0	0.0363357	0.03130512	0	0	0.967	0.7294	1.4519	1.3354
Dam	25-Jul-01	0	0	0	0	0	0.00354328	0.00200934	0	0	0.9472	0.5944	0.8995	0.7951
Dam	2-Aug-01	0	0	0	0	0	0	0	0	0	1	1	0.1234	0.1234
Dam	8-Aug-01	0	0	0	0	0	0.02988105	0.0056483	0	0	1	1	0.3672	0.3672
Fenstermaker	8-Aug-01	0	0.0146744	0.00496756	0.0146744	0.00496756	0.01575378	0.02737408	0	0	0.9395	0.8356	1.0307	1.0132
Little Hole Draw	20-Jun-01	0	0	0	0	0	0.04885132	0.04706284	0	0	0.4884	0.396	1.3525	1.2885
Little Hole Draw	3-Jul-01	0	0.00919425	0.00510189	0.00919425	0.00510189	0.09979623	0.32382224	0	0	0.4335	0.0908	1.8531	1.335
Little Hole Draw	12-Jul-01	0	0.00141335	0.00018815	0.00141335	0.00018815	0.00494681	0.00141111	0	0	0.846	0.7441	1.4941	1.4207
Little Hole Draw	25-Jul-01	0	0.0221657	0.01751124	0.0221657	0.01751124	0.0614019	0.08245537	0	0	0.9438	0.8854	1.6703	1.6547
Little Hole Draw	2-Aug-01	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Hole Draw	8-Aug-01	0	0	0	0	0	0.01085201	0.00034412	0	0	1	1	0.3866	0.3866
County Boundary	6-Jun-01	0	0.14866015	0.0095572	0.14866015	0.0095572	0.01407551	0.00253373	0.0757	0.0757	0	0	2.4981	2.332
County Boundary	20-Jun-01	0	0.0083172	0.00786573	0.0083172	0.00786573	0.0489975	0.09623225	0	0	0.9079	0.7646	1.7465	1.7049
County Boundary	3-Jul-01	0	0.00842208	0.00622684	0.00842208	0.00622684	0.00493708	0.0120599	0.6263	0.6263	0.9242	0.8686	1.3609	1.3491
County Boundary	12-Jul-01	0	0.04787521	0.04014837	0.04787521	0.04014837	0.04965728	0.06433544	0.0711	0.0711	0.8609	0.8133	1.6424	1.6301
County Boundary	25-Jul-01	0.00329822	0.04021541	0.03628045	0.04021541	0.03628045	0.07994495	0.08567759	0.0907	0.0907	0.9103	0.8832	1.6229	1.616
County Boundary	2-Aug-01	0.05492377	0.23835041	0.1391993	0.23835041	0.1391993	0.18464327	0.10783373	0.6921	0.6921	0.5077	0.4686	3.9284	3.8708

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Table 2-7. Nitrogen:phosphorus ratios from DEQ column sampling of American Falls Reservoir, May 2001 to August 2003.

Site	Statistic	Date sampled	TIN:OP ratio	TN:TP ratio	Chl *a* (mg/m^3)
Dam		6/6/2001	4.0	7.8	3.6
		6/20/2001	3.9	8.2	3.4
		7/3/2001	5.5	8.3	3.5
		7/12/2001	4.2	7.0	2.0
		7/19/2001	2.3	6.1	0.6
		7/25/2001	1.6	4.2	11.7
		8/2/2001	1.0	8.5	40.6
		8/8/2001	1.6	7.1	2.2
	Site average		3.0	7.2	
Fenstermaker		8/8/2001	5.6	9.7	14.0
Little Hole Draw		6/20/2001	9.2	11.8	7.8
		7/3/2001	5.4	8.2	11.2
		7/12/2001	4.9	7.0	13.2
		7/25/2001	7.3	6.1	6.4
		8/2/2001	5.0	8.3	57.2
		8/8/2001	9.3	6.8	15.6
	Site average		6.9	8.0	
County boundary		6/6/2001	7.1	9.5	8.3
		6/20/2001	23.0	15.0	6.2
		7/3/2001	6.8	8.8	26.4
		7/12/2001	36.7	8.1	33.1
		7/25/2001	28.6	8.7	8.4
		8/2/2001	40.8	8.7	12.1
	Site average		23.8	9.8	
All	Annual average		10.2	8.3	
Dam		6/4/2002		8.7	6.0
		6/20/2002	2.8	10.7	7.5
		7/2/2002	2.6	3.5	6.3
		7/15/2002	10.0	4.8	9.7
		7/31/2002	1.1	6.8	26.9
	Site average		4.1	6.9	
Fenstermaker		6/4/2002		9.1	6.0
		7/15/2002	4.3	6.8	17.6
	Site average			8.0	
Little Hole Draw		6/4/2002	5.2	9.8	2.7
		6/20/2002	2.3	8.9	17.5
		7/2/2002		7.2	14.9
		7/15/2002	6.2	7.3	16.2
	Site average		4.5	8.3	
County boundary		6/4/2002	5.5	11.3	11.4
		7/2/2002	6.7	6.8	18.3
		7/15/2002	8.3	10.7	41.6
	Site average		6.8	9.6	
All	Annual average		5.0	8.0	
Dam		6/9/2003	4.8	8.4	4.3
		6/26/2003	3.8	6.8	4.6
		7/11/2003	2.6	5.6	13.4
		7/23/2003	1.7	5.4	9.0
		8/5/2003	0.9	5.1	30.5
	Site average		2.8	6.3	
Fenstermaker		6/26/2003	4.0	7.5	4.1
		7/23/2003	0.6	6.9	24.2
		8/5/2003	0.8	8.5	68.6
	Site average		1.8	7.6	
Little Hole Draw		5/28/2003	5.0	12.3	2.1
		6/9/2003	5.0	8.0	3.0
		6/26/2003	4.6	7.3	5.0
		7/23/2003	3.9	5.6	7.9
		8/5/2003	33.3	6.6	33.0
	Site average		10.4	8.0	
County boundary		5/28/2003	12.0	11.4	17.0
		6/9/2003	7.8	7.1	6.4
		6/26/2003	43.3	9.2	23.4
		7/11/2003	63.3	10.7	7.5
	Site average		31.6	9.6	
All	Annual average		11.6	7.8	

American Falls Reservoir. However, Ben Cope and Peter Leinenbach of EPA (personal communication) concluded phosphorus is likely the limiting nutrient in the reservoir, based on several factors, including algal community structure, temporal nitrogen:phosphorus ratios, and nutrient saturation concentrations. DEQ agrees that site-specific information for this reservoir indicates that phosphorus is most likely the limiting nutrient.

From chlorophyll *a* data, American Falls Reservoir falls in the range (0.009-0.025 mg/L) of eutrophic waterbodies (NRCS 1999). EPA (2000) Criteria found an aggregate value of 0.0034 mg/L of chlorophyll *a* for reference conditions in Xeric West ecoregion, which would include American Falls Subbasin. The State of Oregon uses 0.015 mg/L (based on an average of a minimum three samples collected over any three consecutive months at a minimum of one representative location) to identify waterbodies where phytoplankton may impair the recognized beneficial uses (IDEQ and ODEQ 2001). Annual mean densities at all sites show American Falls Reservoir consistently above this criterion (Table 2-3).

It is difficult to make a conclusion on status of American Falls Reservoir when Secchi depth readings (a measure of water clarity) data (Appendix B) are compared to EPA (2000) Criteria. Most (13) Secchi readings recorded at the dam exceeded the aggregate reference condition of 2.7 meters, and 20 of 21 measurements were within or greater than the range of reference conditions (1.4-3.1 meters). Only 1 of 7 readings at Fenstermaker Point was less than the reference condition range, but only 2 were greater than the aggregate reference condition. Slightly over half of the 17 measurements at Little Hole Draw point were higher than the aggregate reference condition, or fell within or exceeded the range of reference conditions. At the County Boundary site, Secchi readings were greater than the aggregate reference condition on only three dates, with slightly less than half of the 16 events within or exceeding the reference conditions range.

Composition of the phytoplankton community is associated with higher levels of organic pollution. Values greater than 20 in the Palmer Water Quality Index (Person 1989) indicate high organic pollution. Scores greater than 20 were observed at Little Hole Draw and county boundary sites in July and August 2001 (Table 2-5). Phytoplankton at Fenstermaker Point collected during the one sampling event in August scored 15 on the Palmer index indicating probable organic pollution. All scores at the dam site were below 10, signifying less organic pollution.

Excessive nutrients and concomitant vegetative growth often result in decreases in dissolved oxygen and increases in pH. Field parameters were measured every meter in the water column as part of the DEQ reservoir sampling protocol (Appendix B). On three occasions (20 Jun 01 and 2 Jul 02 at the dam and 12 Jul 01 at Little Hole Draw), all column dissolved oxygen levels were below the 6.0 mg/L water quality standard. Total days monitored over the three years were 21 days at the dam and 17 days at Little Hole Draw. To check for diurnal trends, DEQ sampled the water column every hour for 24 hours in July 2002 at a site close to American Falls Dam (Appendix B). No dissolved oxygen or pH problems were observed.

Although higher levels of nutrients and algae may be affecting water quality, forage conditions for trout in American Falls Reservoir have been rated excellent. Idaho Department of Fish and Game compared reservoirs throughout Idaho as to zooplankton populations and their potential as trout forage resources (Teuscher 1999). American Falls Reservoir was rated second highest in the state.

In addition to potential problems associated with dissolved oxygen, DEQ sampling revealed water temperatures exceeding state water quality standards for coldwater aquatic life. Water column temperatures exceeded the instantaneous water quality standard of 22^{o}C for coldwater aquatic life at several sites, especially in July (Appendix B). The 24-hour sampling effort by DEQ showed temperatures consistently above the 22^{o}C threshold (Appendix B).

These data justify listing of American Falls Reservoir for flow alteration, nutrients, and dissolved oxygen, but not sediment (Table 2-1). Flow alteration has had effects in the subbasin as hydrology of Snake River has been altered by the Minidoka Project through the construction of dams and operation of the system for irrigation needs. It appears that phosphorus levels in the reservoir are high compared to EPA criteria, and phosphorus is most likely the limiting nutrient to vegetative growth in the reservoir. However, some uncertainty exists as to whether nitrogen is at times the limiting nutrient in the reservoir, and it may be that increased levels of either phosphorus or nitrogen will lead to excessive chlorophyll *a* levels. High algal densities contribute to low dissolved oxygen levels observed in the reservoir. Although reports point out that sloughing of shoreline has added to sediment loading in the reservoir, no data were discovered indicating impairment of beneficial uses. The overall estimated reduction in storage is low at least compared to thresholds used in Nebraska to identify reservoirs with concerns about volume loss due to sedimentation. Temperature data documented exceedances of water quality standards for coldwater aquatic life, and the reservoir should be considered for listing as having temperature problems on the next 303(d) list.

Snake River

Flow in the section of Snake River above the reservoir has been greatly modified by the Minidoka Project. Total annual flow averages about 60,000 cfs (Table 1-3). Annual average flow has ranged from about 1,000 cfs to over 12,000 cfs (Figure 2-5). Highest flows occur in April to June followed by the lowest flows in August and September (Figure 1-5).

Both segments of Snake River are listed as having sediment problems while the upper segment is also listed for dissolved oxygen, flow alteration, and nutrients (Table 2-1). DEQ and USGS, working under DEQ contract, began sampling Snake River in 2000. Sites include bridges at Shelley, Firth, Blackfoot, and Ferry Butte (Tilden Bridge). In November of 2002, sampling at Shelley and Firth wastewater treatment plants was implemented.

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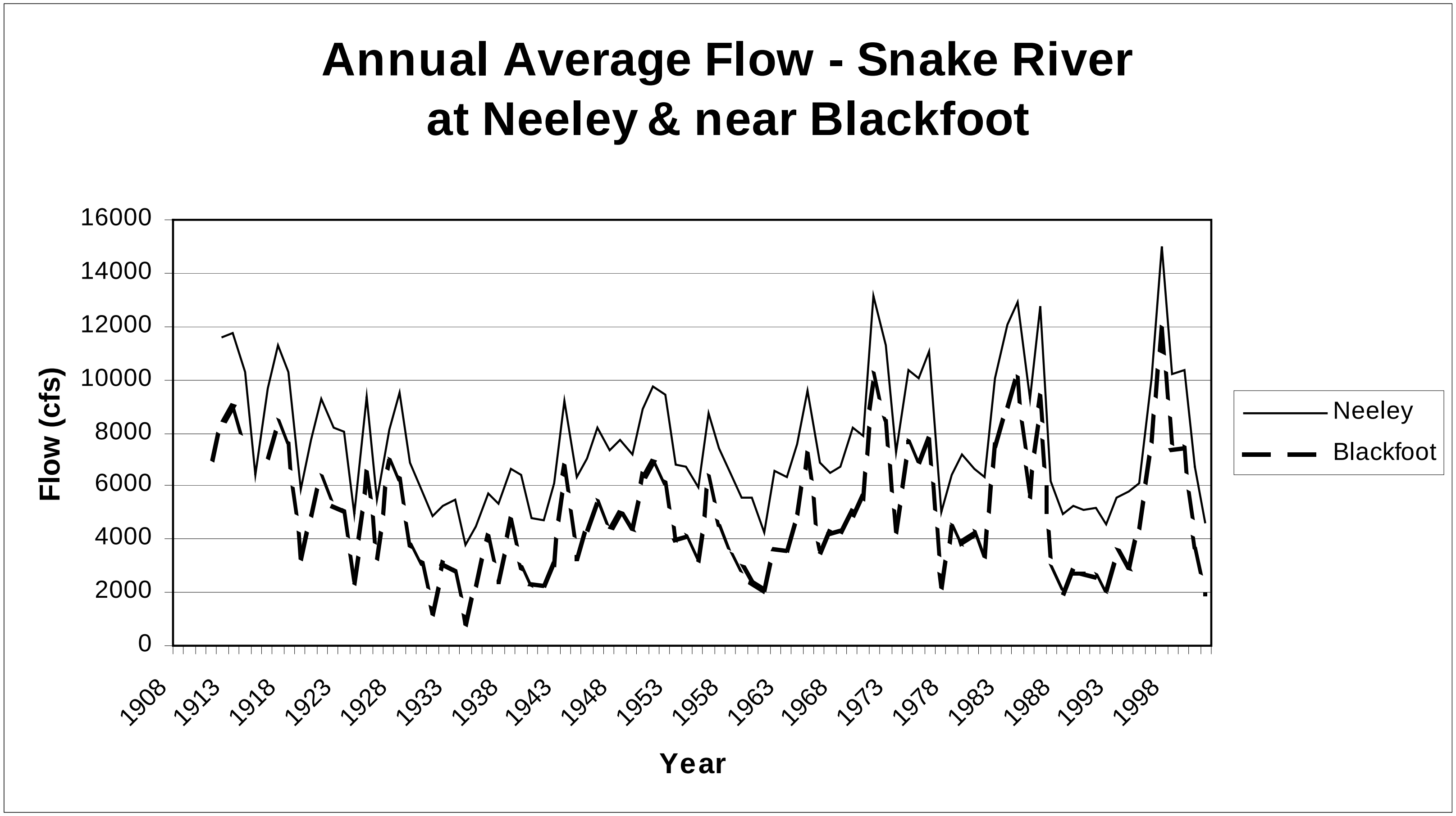

Figure 2-5. Annual (calendar year) average flow in the Snake River at Neeley (13077000) and near Blackfoot (13069500) USGS surface-water stations.

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Overall averages from Snake River sampling do not indicate that levels of nutrients or sediment are impairing beneficial uses (Table 2-8, Appendix C). Average total phosphorus did not exceed 0.035 mg/L, which was less than the EPA water quality criteria guidance recommendation of 0.1 mg/L (EPA 1986). Based on EPA (2000) Criteria, total phosphorus is higher than the 25th percentile aggregate value of 0.022 mg/L for reference sites but well within the range (0.010-0.055 mg/L) of those sites. Using similar criteria, total nitrogen (nitrate+nitrite plus total Kjeldahl nitrogen) is close to the aggregate value for reference conditions of 0.38 mg/L, ranging from 0.330 mg/L at Blackfoot to 0.402 mg/L at Ferry Butte (Tilden Bridge).

Total suspended solids/suspended sediment concentration (TSS/SSC) was also low. The highest average TSS/SSC was 15 mg/L at Ferry Butte (Tilden Bridge). A maximum value of 79 mg/L also was observed Ferry Butte. USGS bedload sampling showed most of the sediment load in Snake River is passing in the suspended state (Table 2-9, Appendix C). Generally, bedload on the sampling dates in 2000 to 2002 was less than 4 mm (< 0.16 in) and greater than 0.25 mm (> 0.01 in); however, higher water years may show a different pattern. For example, flows in 1997 moved tremendous amounts of cobble-sized sediment in the Blackfoot area of the Snake River (Lynn Van Every, Idaho Department of Environmental Quality, personal communication).

Three wastewater treatment plants discharge directly into Snake River. Although wastewater treatment plants at Blackfoot, Firth, and Shelley are contributing nutrients and sediment to Snake River (Appendix D), it appears they are having little measurable effect on water quality or beneficial uses as assessed at the four bridge sites.

Stormwater runoff from part of the City of Blackfoot drains to Snake River. Limited stormwater runoff data were available from two sites monitored in June of 2001 and March of 2002 with marked differences in pollutant levels observed between the two events (Table 2-10). Sampling in 2001 and 2002 showed average total phosphorus of 0.42 mg/L and 1.57 mg/L, respectively. Average nitrate+nitrite (no other nitrogen form was analyzed) ranged from 0.26 mg/L in 2001 to 0.90 in 2002. Total suspended solids concentrations averaged 81 mg/L in 2000 and 462 mg/L in 2001. From data collected on mainstem Snake River by DEQ, it appears that present loads from City of Blackfoot stormwater runoff are having minimal, if any, effect on water quality or beneficial uses in the river.

Temperature monitoring was conducted by USGS at Snake River near Shelley and near Blackfoot gage sites (Table 2-11, Appendix C). In 2001, maximum temperatures exceeded 20^{o}C in July and August. The river was warmer in 2002 when maximum values surpassed 20^{o}C in June through September. Mean monthly temperatures were greater than 20^{o}C at both sites in 2002 only.

Exceedances of temperature water quality standards were observed at both sites in both years (Table 2-12). Only maximum instantaneous temperature at the near Shelley gage in 2001 was not exceeded. Daily average temperature exceedances occurred one in every three days at both gage sites in 2002

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Table 2-8. Descriptive statistics from USGS and DEQ sampling data on Snake River at four bridge sites, April 2000 to July 2003.

Statistic	Tilden	Blackfoot	Firth	Shelley	Tilden	Blackfoot	Firth	Shelley	Tilden	Blackfoot	Firth	Shelley
	Total ammonia as N (mg/L)				**NO_2 + NO_3 as N (mg/L)**				**Total Kjeldahl nitrogen (mg/L)**			
Average	0.012	0.024	0.018	0.020	0.110	0.078	0.109	0.142	0.292	0.252	0.239	0.210
St Dev	0.013	0.046	0.013	0.021	0.091	0.095	0.100	0.094	0.145	0.097	0.070	0.059
Count	59	38	37	59	59	38	37	59	59	38	37	59
Maximum	0.080	0.270	0.061	0.094	0.413	0.302	0.334	0.355	1.000	0.530	0.410	0.390
Minimum	0.001	0.003	0.003	0.001	0.023	0.003	0.003	0.030	0.120	0.120	0.120	0.120
Median	0.008	0.011	0.017	0.011	0.078	0.035	0.086	0.109	0.250	0.220	0.240	0.200
	Dissolved orthophosphorus as P (mg/L)				**Total phosphorus (mg/L)**							
Average	0.006	0.007	0.009	0.010	0.035	0.029	0.035	0.029				
St Dev	0.004	0.012	0.007	0.007	0.018	0.014	0.020	0.010				
Count	59	38	37	58	59	38	37	59				
Maximum	0.020	0.074	0.038	0.026	0.096	0.064	0.096	0.064				
Minimum	0.001	0.003	0.003	0.002	0.009	0.008	0.014	0.013				
Median	0.004	0.005	0.008	0.008	0.031	0.026	0.027	0.026				
	TSS/SSC (mg/l)				**Turbidity (mg/L)**							
Average	15.1	6.9	7.3	5.9	5.0	6.1	4.6	4.6				
St Dev	13.8	5.1	6.6	4.9	4.0	3.0	2.8	3.2				
Count	59	38	37	59	39	3	3	38				
Maximum	79	18	30	24	22.0	9.3	7.6	14.0				
Minimum	0.5	0.5	0.5	0.5	0.3	3.2	2.0	0.3				
Median	13.0	5.8	5.2	4.0	4.3	5.7	4.3	3.8				

Table 2-9. USGS bedload sampling at Snake River near Shelley gage site (13060000), 2000 to 2002.

Site	Year	Days sampled (bedload/ suspended sediment)	Mean suspended sediment (tons/day)	Mean bedload sediment (tons/day)	Mean sediment bedload sieve diameter, percent finer than										
					.062 mm	.125 mm	.250 mm	.500 mm	1.00 mm	2.00 mm	4.00 mm	8.00 mm	16.0 mm	32.0 mm	64.0 mm
nr Shelley	2000	4/12	176.83	0.27	0.00	0.63	5.50	68.50	82.50	93.50	100.00	100.00	100.00	100.00	100.00
	2001	4/12	70.55	0.40	0.00	1.50	13.63	59.38	78.50	92.13	100.00	100.00	100.00	100.00	100.00
	2002	4/12	100.78	0.07	14.75	17.79	26.00	60.50	73.63	91.88	100.00	100.00	100.00	100.00	100.00
	Average		116.05	0.25	4.92	6.64	15.04	62.79	78.21	92.50	100.00	100.00	100.00	100.00	100.00
nr Blackfoot	2000	4/12	286.42	17.98	0.00	1.38	7.25	71.00	90.38	93.88	94.75	94.88	97.13	98.50	100.00
	2001	4/12	74.03	0.99	1.00	2.88	15.00	70.50	90.88	97.75	100.00	100.00	100.00	100.00	100.00
	2002	4/12	195.55	2.49	0.79	2.65	14.83	78.13	96.63	98.75	99.50	100.00	100.00	100.00	100.00
	Average		185.33	7.15	0.60	2.30	12.36	73.21	92.63	96.79	98.08	98.29	99.04	99.50	100.00

Table 2-10. Stormwater runoff data from sampling by City of Blackfoot and DEQ for two discharges to the Snake River, June 2001 and March 2002.

Location in Blackfoot	Alkalinity (mg/L)	COD (mg/L)	Total cadmium (*u* g/l)	Chloride (mg/L)	Total chromium (*u* g/l)	Total lead (*u* g/l)	Total nickel (*u* g/l)	Ortho-phosphate as P (mg/L)	Sulphate as SO4 (mg/L)	Total dissolved solids (mg/L)	Total nitrate as N (mg/L)	Total nitrite as N (mg/L)	Total phosphorus as P (mg/L)	Total suspended solids (mg/L)	Total zinc (*u* g/l)	Fecal coliform (cfu/100 ml)	*E. coli* (cfu/100 ml)
13-Jun-01																	
Behind Albertsons	124	77	<1	8.99	6	14	<5	0.274	31.8		0.287	0.017	0.507	99	106	200	900
Behind Wal Mart	115	43	<1	7.41	<5	7	<5	0.231	28.8		0.191	0.019	0.332	62	74	1500	200
6-Mar-02																	
Behind Albertsons	51	220	2	69.8	27	46	14	1.33	6.98	240	0.832	0.06	1.71	434	321		
Behind Wal Mart	82	191	2	64.6	25	44	12	1.3	11.9	255	0.842	0.058	1.42	490	275		

Table 2-11. USGS Snake River temperature monitoring data.

Date	Water Year 2000						Water Year 2001					
	Temperature (°C) nr Shelley			Temperature (°C) nr Blackfoot			Temperature (°C) nr Shelley			Temperature (°C) nr Blackfoot		
	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean
May	14.9	7.2	11.1	15.6	7.9	12.1	17.7	7.7	12.7	18.2	9.3	14.1
June	18.2	11.2	14.6				20.9	10.2	15.4	22.8	11.3	16.6
July	21.3	15.2	17.8				23.4	17.2	19.7	23.5	17.4	20.3
August	21.8	16.2	18.9	23.1	15.8	19.4	24.3	16.7	20.0	23.0	17.1	20.0
September				19.5	10.2	15	21.2	13.4	16.5	20.3	14.1	16.5

Table 2-12. Temperature exceedances of state water quality standards in Snake River (from USGS temperature monitoring data).

	WY2000				WY2001			
	nr Shelley		nr Blackfoot		nr Shelley		nr Blackfoot	
	Instantaneous (> 22°C)	Daily average (> 19°C)	Instantaneous (> 22°C)	Daily average (> 19°C)	Instantaneous (> 22°C)	Daily average (> 19°C)	Instantaneous (> 22°C)	Daily average (> 19°C)
Total number of days of exceedances	0	16	9	27	31	60	23	68
Number of days sampled	149	149	142	142	177	177	178	178

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In August and September 2002, DEQ deployed continuous (interval=15 minutes) monitoring sondes at four sites in Snake River for about a one-week period. Temperature and dissolved oxygen data showed no water quality exceedances at the sites (Figure 2-6).

Additional to their work under contract with DEQ, USGS has monitored Snake River as part of their National Water-Quality Assessment (NAWQA) work. USGS investigated pesticide and organic compound contamination in the upper Snake River Basin (Maret and Ott 1997). Fish collected from Snake River near Blackfoot and Spring Creek near Fort Hall had detectable concentrations of dichlorodiphenyltrichloroethane (DDT) metabolites. Snake River fish also showed detectable levels of polychlorinated biphenyls (PCB) and chlordane. No organochlorine compounds were detectable in bed sediment from either site. Observed concentrations fell below recommended maximum concentrations (NAS/NAE 1973 cited in Maret and Ott 1997).

The NAWQA study also analyzed for pesticides at three sites in the subbasin: Snake River near Shelley and near Blackfoot, and Ross Fork near Fort Hall. Both atrazine and EPTC (s-ethyl dipropylthiocarbamate) were detected (Ott 1997). Atrazine concentrations were less than 0.02 *u*g/L and EPTC concentrations were less than 0.2 *u*g/L. Maximum contaminant level (maximum level of certain contaminants permitted in drinking water) for atrazine is 3 *u*g/L. There is no maximum contaminant level (MCL) for EPTC.

Low and Mullins (1990) studied water quality, bottom sediment, and biota associated with irrigation drainage in the reservoir area. They concluded biotic concentrations for trace elements were low except for mercury and selenium. The authors expressed concern regarding levels of selenium in mallard duck livers. In addition, DDT metabolites were detected in all waterbird eggs (especially cormorant), although concentrations did not exceed criterion for protection of aquatic life.

In conclusion, data do not support listing of Snake River for dissolved oxygen and nutrients (Table 2-1). Sediment also does not appear to be impairing beneficial uses, but the effect of bedload and water column sediment in average to high water years is unknown. Until such data are collected, or BURP assessment indicates beneficial support, it is recommended that Snake River continue to be listed for sediment. As mentioned previously, flow alteration has occurred as Snake River hydrology has been modified as part of BOR's Minidoka Project. Data do indicate temperature problems. Organic compounds, pesticides, and metals have been detected in the subbasin. The greatest concern appears to be the possible effect of these chemicals and metals on waterbird populations. Snake River will be recommended for delisting of dissolved oxygen and nutrients, and should be considered for listing of temperature on the next 303(d) list.

Bannock Creek

Streamflow on Bannock Creek was monitored by USGS from June 1985 to September 1994. Average total annual flow during this period of record was 467 cfs, ranging from 267 cfs to

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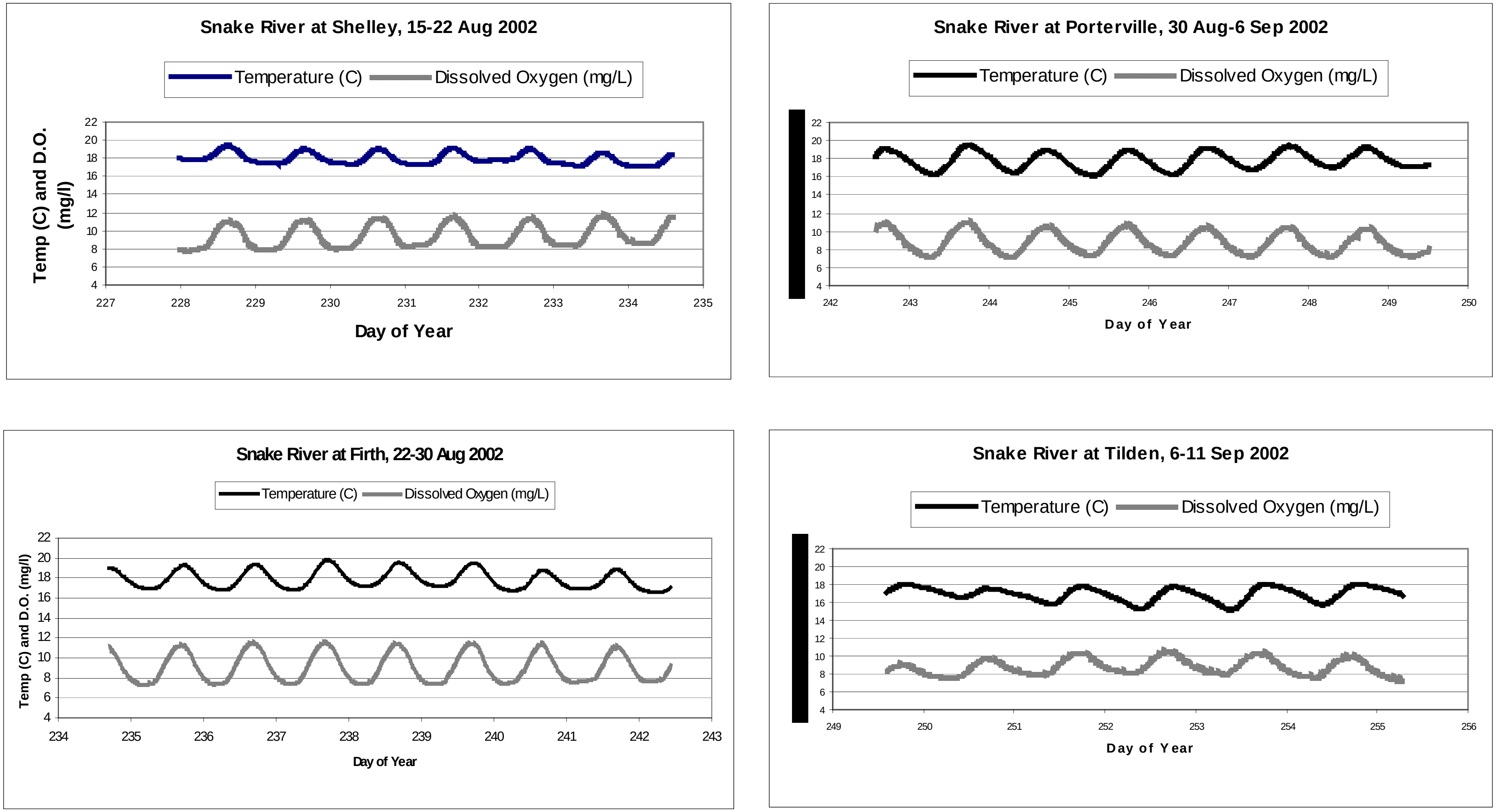

Figure 2-6. DEQ continuous (15-minute interval) monitoring data from Snake River, August, September 2002.

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1006 cfs (Table 1-3). The average annual hydrograph showed peak runoff occurring early in the year in February and March (Figure 2-7) and lowest flows occurring in August. No USGS flow data were available for Bannock Creek tributaries West Fork, Moonshine, Rattlesnake, and Knox creeks.

Data assessment completed on Bannock Creek watershed supports inclusion of Bannock Creek watershed on the 303(d) list. Bannock Creek was listed on the 1998 303d list for bacteria, nutrients, and sediment. Data collected from BURP showed high levels of surface sediment in both Bannock and Rattlesnake creeks (Table 1-7) and lower levels of sediment were found in Knox Creek. BOR monitoring of Bannock Creek showed high levels of suspended sediment averaging 73 mg/L over the sample period (Table 2-13, Appendix E). Total nitrogen and total phosphorus averaged 1.69 and 0.36 mg/L, respectively. For Xeric West streams, both of these levels exceeded the 25th percentile aggregate nutrient reference conditions although the total phosphorus concentration was within the range of reference conditions (EPA 2000). Assessment of BURP data following DEQ's waterbody assessment guidance (Grafe et al. 2002) indicated none of these three streams was supporting beneficial uses for coldwater aquatic life (Table 2-14). Additionally, Rattlesnake and Knox creeks have high levels of sediment, which likely contributed to a listing of not supporting coldwater aquatic life. BURP monitoring data has not been collected on Moonshine Creek or West Fork due to access restrictions. Nutrient and sediment data from Shoshone-Bannock Tribes' 2003 sampling program are summarized in Table 2-15.

While the 1998 303(d) list identified bacteria as a problem in Bannock Creek, lack of data prohibits an adequate use impairment determination or a pollutant load allocation from being conducted. Only two samples were collected in Bannock Creek in June 2000 both of which occurred at a site outside of the Fort Hall boundary. While the two samples had a geometric mean of 420 *E. coli* colonies/100 ml of water, exceeding the state water quality standard of 126 colonies/100 ml, lack of the required number of samples (i.e., five samples within a 30-day period) resulted in insufficient data to conduct an adequate assessment of the secondary contact recreation use designated for Bannock Creek. The Shoshone-Bannock Tribes and DEQ recommend a collaborative monitoring effort to collect more bacteria data that is representative of water quality conditions in Bannock Creek, prior to developing a TMDL.

Evaluation of the fish community in Bannock Creek watershed is limited. Fish distribution surveys were conducted by USFS in August 2001 on two tributaries to Rattlesnake Creek, Crystal and Midnight creeks (USFS 2001). On that sampling date both surveys revealed no running water in either stream and both were deemed non-fish sustaining waterbodies.

Other tributaries

Amongst other tributaries, only McTucker Creek is on the 303(d) list. BOR sampling indicated an average flow of 187 cfs (Table 2-16). Highest flow of 300 cfs was observed in both June 2002 and July 2003. The lowest flow recorded was in June of 2001 at 17 cfs; however, this recording is suspect as next lowest recorded flow was 120 cfs in November 2002. Excluding the 17 cfs value, flow averaged 199 cfs.

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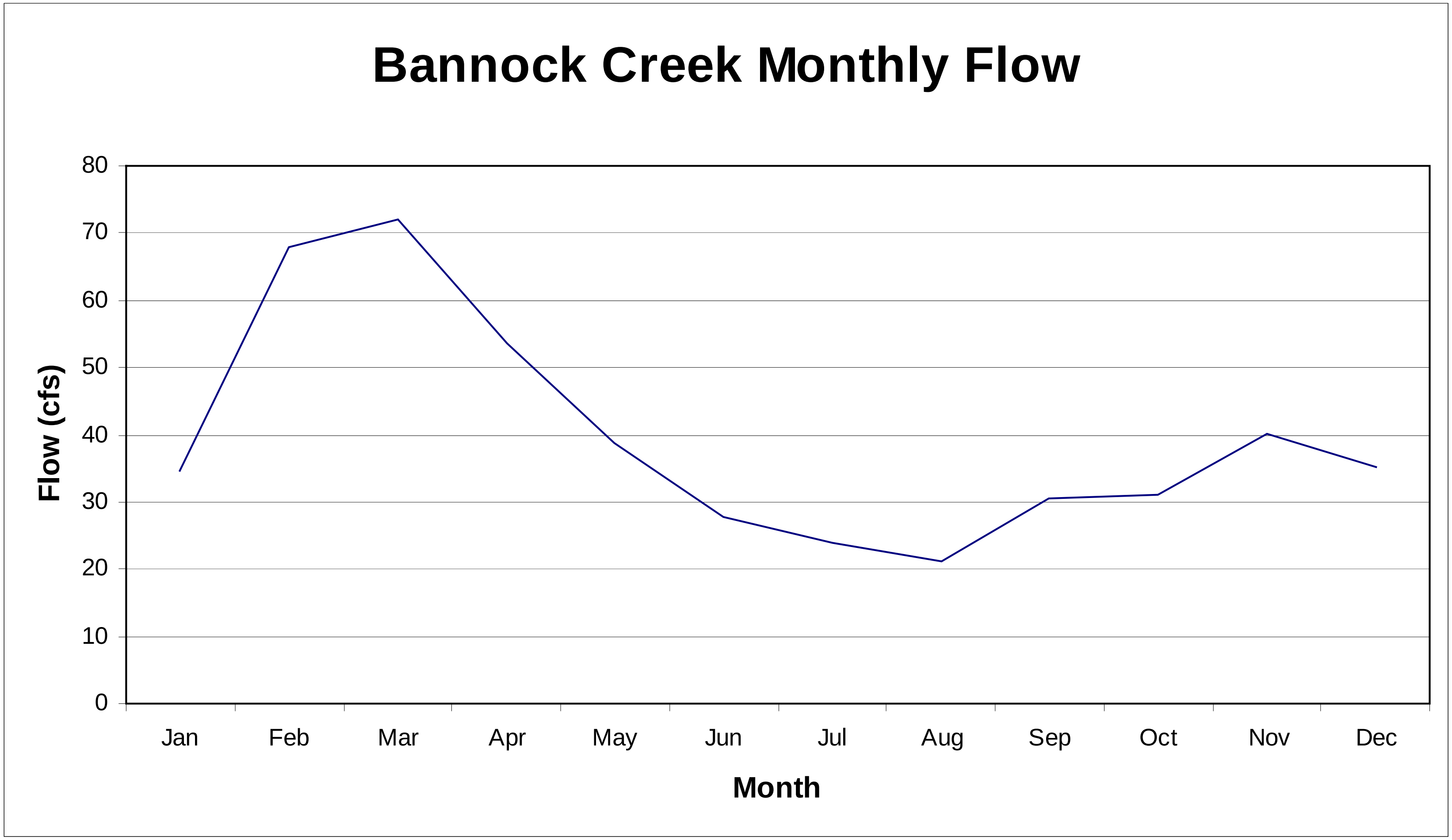

Figure 2-7. Average monthly flow at Bannock Creek USGS surface-water station (13076200), June 1985 to September 1994.

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Table 2-13. Descriptive statistics from BOR sampling of American Falls Reservoir tributaries, springs, and drains.

Waterbody	Statistic[1]	Flow (cfs)	Ortho P (mg/L)	Total P (mg/L)	NH_3 (mg/L)	NO_3+NO_2 (mg/L)	TKN (mg/L)	TN (mg/L)	SS (mg/L)
Bannock Cr	Average	34.8	0.268	0.361	0.027	1.238	0.421	1.688	73.4
	Count	23	23	23	23	23	22	22	23
	Standard Deviation	20.3	0.268	0.260	0.022	0.778	0.368	0.780	162.0
	Maximum	104.0	0.803	0.850	0.100	2.650	1.990	3.000	778.0
	Minimum	12.0	0.019	0.081	0.005	0.410	0.180	0.680	2.0
	Median	32.8	0.126	0.300	0.020	1.030	0.355	1.590	24.0
Cedar Spillway	Average	31.1	0.003	0.020	0.012	0.027	0.253	0.235	10.0
	Count	6	17	18	10	17	10	18	17
	Standard Deviation	19.5	0.002	0.015	0.007	0.054	0.112	0.289	9.2
	Maximum	54.0	0.010	0.068	0.020	0.200	0.520	1.200	34.5
	Minimum	7.8	0.001	0.000	0.005	0.000	0.150	0.000	0.5
	Median	34.0	0.002	0.019	0.008	0.005	0.210	0.180	8.0
Clear Cr	Average	37.2	0.010	0.029	0.016	1.499	0.221	1.740	10.0
	Count	13	22	22	22	22	21	21	22
	Standard Deviation	31.7	0.003	0.019	0.014	0.141	0.199	0.253	12.7
	Maximum	120.0	0.016	0.077	0.060	1.730	0.880	2.510	48.0
	Minimum	15.0	0.006	0.005	0.005	1.070	0.050	1.440	0.5
	Median	20.0	0.011	0.027	0.010	1.515	0.160	1.620	4.5
Colburn wasteway	Average	5.2	0.013	0.056	0.095	0.649	0.757	1.419	12.6
	Count	15	24	24	23	24	23	24	24
	Standard Deviation	4.7	0.017	0.041	0.186	0.847	0.457	0.815	15.0
	Maximum	18.0	0.073	0.170	0.920	3.000	2.460	3.320	70.0
	Minimum	1.5	0.002	0.005	0.010	0.005	0.280	0.540	2.0
	Median	3.0	0.007	0.047	0.030	0.260	0.670	1.170	7.5
Crystal wasteway	Average	49.1	0.020	0.048	0.067	1.703	0.362	2.051	13.1
	Count	34	35	35	34	35	33	34	35
	Standard Deviation	11.4	0.012	0.018	0.035	0.329	0.131	0.350	20.4
	Maximum	90.0	0.041	0.094	0.130	2.641	0.940	2.890	101.0
	Minimum	17.0	0.002	0.020	0.005	0.880	0.200	1.170	2.0
	Median	50.0	0.020	0.046	0.070	1.690	0.350	2.020	6.0
Danielson Cr	Average	56.2	0.010	0.035	0.032	0.727	0.250	0.970	11.3
	Count	34	35	35	34	35	33	34	35
	Standard Deviation	8.7	0.006	0.009	0.028	0.252	0.071	0.281	9.8
	Maximum	69.5	0.025	0.054	0.130	1.170	0.420	1.470	59.5
	Minimum	36.0	0.002	0.017	0.005	0.310	0.160	0.530	4.0
	Median	56.0	0.009	0.036	0.020	0.710	0.220	0.915	8.0
Hazard Cr/Little Hole Draw	Average	16.7	0.196	0.248	0.489	1.782	1.137	2.852	9.9
	Count	30	34	34	34	34	33	33	34
	Standard Deviation	18.8	0.221	0.238	0.848	1.936	1.381	2.810	10.3
	Maximum	63.0	0.727	0.820	2.770	5.860	5.400	8.200	49.0
	Minimum	1.0	0.002	0.034	0.005	0.020	0.220	0.350	2.0
	Median	6.8	0.049	0.101	0.040	0.495	0.510	0.960	7.0
McTucker Cr	Average	196.2	0.011	0.034	0.017	0.991	0.220	1.200	7.4
	Count	14	31	31	31	31	30	30	31
	Standard Deviation	83.2	0.009	0.010	0.010	0.463	0.077	0.442	5.4
	Maximum	300.0	0.038	0.061	0.040	2.900	0.370	3.020	21.0
	Minimum	17.0	0.002	0.013	0.005	0.410	0.080	0.660	0.5
	Median	200.0	0.010	0.034	0.020	1.060	0.210	1.210	6.0
Seagull Bay tributary	Average	5.4	0.074	0.216	0.044	0.234	0.577	0.811	138.3
	Count	11	14	14	14	14	14	14	13
	Standard Deviation	5.5	0.061	0.227	0.024	0.234	0.281	0.367	360.8
	Maximum	20.0	0.203	0.980	0.090	0.710	1.380	1.510	1337.0
	Minimum	0.5	0.002	0.087	0.005	0.005	0.320	0.340	10.0
	Median	4.0	0.051	0.157	0.040	0.155	0.500	0.750	52.0
Spring Cr	Average	315.1	0.010	0.025	0.015	1.000	0.143	1.112	8.2
	Count	21	21	21	21	21	20	20	21
	Standard Deviation	23.8	0.004	0.008	0.023	0.163	0.098	0.143	5.4
	Maximum	351.0	0.017	0.044	0.110	1.630	0.500	1.560	24.0
	Minimum	272.0	0.005	0.012	0.005	0.840	0.080	0.930	2.0
	Median	313.0	0.010	0.024	0.010	0.990	0.110	1.100	7.0
Sterling wasteway	Average	5.5	0.020	0.081	0.101	1.116	0.581	1.678	37.2
	Count	21	33	33	33	33	32	32	33
	Standard Deviation	3.5	0.018	0.077	0.234	0.463	0.632	0.855	52.2
	Maximum	14.0	0.083	0.390	1.360	1.800	3.720	5.140	198.0
	Minimum	0.9	0.002	0.022	0.005	0.110	0.230	0.490	3.0
	Median	5.3	0.015	0.051	0.050	1.240	0.425	1.660	14.0
Sunbeam Cr	Average	4.4	0.045	0.246	0.081	0.231	0.762	0.993	95.1
	Count	16	20	20	20	20	20	20	19
	Standard Deviation	3.0	0.029	0.218	0.169	0.317	0.601	0.893	77.3
	Maximum	10.0	0.109	1.080	0.780	1.360	2.720	4.080	332.0
	Minimum	1.0	0.007	0.072	0.005	0.005	0.240	0.275	16.0
	Median	4.0	0.037	0.190	0.035	0.135	0.585	0.735	81.0

[1]statistics not calculable if no data (count=0); standard deviation not calculable with only one data point (count=1)

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Table 2-14. BURP data analysis and waterbody assessment of American Falls Subbasin tributaries.

Waterbody	Site	Year sampled	Index[1] score				Beneficial use[2] support							
			SMI	SFI	SHI	Average	CWAL	SaSp	PCR	SCR	AWS	IWS	W	A
303(d) listed streams														
McTucker Creek		1996	2	1	1	1.33	NS				NA	NA	NA	NA
Bannock Creek	lower	1996	0		1	0	NS	NA			FS	FS	FS	FS
Rattlesnake Creek	upper	1996	0		1	0	NS				NA	NA	NA	NA
	lower	1996	1		1	1	NS				NA	NA	NA	NA
Knox Creek		1996	0		3	0	NS				NA	NA	NA	NA
Non-303(d) listed streams														
Danielson Creek		1998	1		1	1	NS	NS		NA	FS	FS	FS	FS
Hazard Creek/ Little Hole Draw		1998	0		1	0	NS	NS		NA	FS	FS	FS	FS
Michaud Creek	upper	1997	3		2	2.5	FS	FS		FS	FS	FS	FS	FS
	lower	1997	3		1	2								
Crystal Creek		1998	2		3	2.5	FS	FS		NA	FS	FS	FS	FS
Sunbeam Creek		1998	0		1	0	NS				NA	NA	NA	NA

[1] SMI=stream macroinvertebrate index, SFI=stream fish index, SHI=stream habitat index; index score average defaults to 0 if any index score is 0

[2] CWAL=coldwater aquatic life, SaSp=salmonid spawning, PCR=primary contact recreation, SCR=secondary contact recreation, AWS=agriculture water supply, IWS=industrial water supply, W=wildife, A=aesthetics, NS=not supported, NA=not assessed, FS=fully supported

Table 2-15. Shoshone-Bannock Tribes nutrient sampling results from Bannock Creek watershed.

Site	Date	Parameter						
		Total Kjeldahl nitrogen (mg/L)	Ammonia nitrogen (mg/L)	Nitrate+ nitrite (mg/L)	Total nitrogen (mg/L)[1]	Total phosphorus (mg/L)	Ortho-phosphorus (mg/L)	Total suspended solids (mg/L)
West Fork Bannock Creek	Apr-03	0.5	0.02	0.02	0.52	0.02	ND	6
	Jul-03	ND	ND	ND	ND	0.0122	ND	6.2
Lower Bannock Creek	Apr-03	0.5	0.02	0.549	1.05	0.0279	0.07	12.8
	Jul-03	3.71	ND	1.19	4.9	0.467	0.28	23.4
Upper Moonshine Creek	Apr-03	1.12	0.02	0.396	1.52	0.408	ND	454
	Jul-03	1.2	0.108	0.697	1.897	0.487	0.14	251
Lower Moonshine Creek	Apr-03	0.5	0.02	0.02	0.52	0.0202	ND	12
	Jul-03	ND	ND	0.0531	ND	0.015	ND	6.06
Upper Rattlesnake Creek	Apr-03	1.19	0.03	0.13	1.32	0.707	0.06	734
	Jul-03	ND	ND	0.0419	ND	0.145	0.08	14.2
Lower Rattlesnake Creek	Apr-03	0.5	0.02	0.04	0.54	0.124	ND	75.9
	Jul-03	ND	ND	ND	ND	0.0883	0.05	2.2

[1]total nitrogen = total Kjeldahl nitrogen + nitrate+nitrite

Table 2-16. BOR flow data from McTucker Creek near ponds.

Date	Flow (cfs)	Comments
11-Jun-01	17	
1-May-02	140	
4-Jun-02	300	Estimate
26-Jun-02	220	Estimate
9-Jul-02	270	Estimate
13-Aug-02	200	Estimate
9-Oct-02	160	Estimate
29-Oct-02	130	Estimate
29-Oct-02	130	Estimate
25-Nov-02	120	Estimate
25-Nov-02	121	Estimate
12-Mar-03	280	Estimate
1-Apr-03	200	Estimate
24-Apr-03	140	Estimate
12-May-03	270	Estimate
8-Jul-03	300	Estimate

McTucker Creek is listed for sediment problems (Table 2-1). BURP data indicated levels of streambed surface fines in the 60% range (Table 1-7). Average suspended sediment concentration collected by BOR was only 7.44 mg/L with a high of 21 mg/L (Table 2-13, Appendix E). Waterbody assessment of McTucker Creek BURP data showed non support of coldwater aquatic life (Table 2-14). Streambed sediment levels are high, although data indicate water column suspended sediment is not. This could be a result of historic sediment loading which, due to the low gradient and spring-like nature of McTucker Creek, has yet to be transported out of the system.

Two entities monitor streams, springs, and drains that flow into American Falls Reservoir. In addition to Bureau of Reclamation, Neil and Marita Poulson through funding from various sources (Idaho State University, Aberdeen-Springfield Canal Company, DEQ, and others) have been monitoring on reservoir's west side. Some waterbodies are sampled as part of both efforts. Although these waterbodies are not on the 303(d) list, they could contribute to both nutrient and sediment loading in the reservoir.

A summary of BOR data for waterbodies with at least ten sampling events is presented in Table 2-13 (see Appendix E for all data from May 2001 to July 2003). Waterbodies with high levels of sediment were Seagull Bay tributary, Sterling wasteway, and Sunbeam Creek. All three creeks averaged 4-5 cfs flow (Appendix E). Higher concentrations of total nitrogen (> 1.0 mg/L) were recorded in Clear Creek, Colburn wasteway, Crystal wasteway, Hazard Creek/Little Hole Draw, Spring Creek, and Sterling wasteway. Hazard Creek/Little Hole Draw, Seagull Bay tributary, and Sunbeam Creek all had total phosphorus concentrations greater than 0.2 mg/L whereas no other waterbody exceeded 0.08 mg/L. These data indicate many of these waterbodies are contributing to sediment and nutrient loads in American Falls Reservoir.

The Poulsons' work focused on nutrients and sediment from waterbodies entering the reservoir's west side, nutrients in ground water, and nutrients and sediment in Aberdeen-Springfield Canal (Poulson et al. 2001). Initial sampling took place in late 1996 and the project proceeded in earnest in 1997 (Appendix E). High levels of phosphorus (phosphate [PO_4] or total phosphorus greater than 0.05 mg/L) were observed in Cedar Spill, Colburn wetland, Hazard Creek/Little Hole Draw, Smith Spring, and Spring Hollow (Table 2-17). Big Hole springs complex, Colburn wetland, Crystal Springs, Danielson Creek, Smith Spring, Spring Hollow, and Sterling wetland all had nitrogen (nitrate+nitrite and total nitrogen) levels greater than 1.0 mg/L with Spring Hollow the highest at about 10 mg/L.

Data from the Poulsons' efforts were sufficient to derive several conclusions (Poulson et al. 2003). The Aberdeen-Springfield Canal does not represent a large portion of study area nutrient loading to the reservoir. Suspended solids from the canal are of the same order of magnitude as the TSS target. Springs are a major source of nitrogen into the reservoir. Largest contributors of nitrogen were Crystal spring, Spring Hollow drain, and Danielson Creek (Poulson et al. 2001). Phosphorus levels at all sites were rarely greater than target levels (0.05 mg/L)

Table 2-17. Descriptive statistics from streams, canals, and wetlands on north and west sides of American Falls Reservoir, 1997 to 2002.

Waterbody	Statistic[1]	Flow (cfs)	PO_4 (mg P/L)	Total P (mg/L)	NO_3+NO_2 (mg N/L)	Total N (mg/L)	Suspended sediment (mg/L)
Big Hole springs complex	Average	0.71	0.040		4.484		1.7
	Count	1	6	0	7	0	5
	Standard deviation		0.038		1.012		1.6
	Maximum	0.71	0.100		5.659		3.8
	Minimum	0.71	0.000		2.924		0.0
	Median	0.71	0.032		4.660		1.4
Cedar Spill	Average		0.053	0.011	0.694	0.179	86.4
	Count	0	34	8	34	8	34
	Standard deviation		0.204	0.008	3.601	0.417	414.4
	Maximum		1.200	0.025	20.997	1.200	2430.5
	Minimum		0.000	0.000	0.000	0.000	2.0
	Median		0.006	0.013	0.008	0.000	12.4
Colburn (Orth) wetland	Average	13.07	0.032	0.170	0.466	1.740	23.7
	Count	6	19	1	19	1	19
	Standard deviation	13.53	0.043		0.548		23.3
	Maximum	37.08	0.160	0.170	1.962	1.740	70.0
	Minimum	2.12	0.000	0.170	0.000	1.740	0.0
	Median	6.36	0.019	0.170	0.214	1.740	14.6
Crystal Springs	Average	149.95	0.020	0.028	2.407	2.890	17.6
	Count	5	20	3	21	3	20
	Standard deviation	140.44	0.028	0.013	0.934	0.357	27.7
	Maximum	381.40	0.085	0.040	4.410	3.130	90.0
	Minimum	31.78	0.000	0.015	0.943	2.480	0.0
	Median	132.43	0.007	0.030	2.169	3.060	6.0
Danielson Creek	Average	60.39	0.021	0.040	0.828	1.470	14.5
	Count	4	20	1	20	1	20
	Standard deviation	35.09	0.030		0.377		17.3
	Maximum	84.76	0.090	0.040	1.615	1.470	63.5
	Minimum	8.48	0.000	0.040	0.365	1.470	0.0
	Median	74.16	0.007	0.040	0.782	1.470	9.3
Hazard Creek/Little Hole Draw	Average	77.98	0.075		0.250		25.7
	Count	9	25	0	25	0	25
	Standard deviation	35.24	0.124		0.367		32.3
	Maximum	148.32	0.619		1.800		159.7
	Minimum	17.76	0.000		0.005		6.2
	Median	79.46	0.030		0.150		15.0
Nash Spill	Average		0.002	0.013	0.006	0.094	9.5
	Count	0	3	4	3	4	3
	Standard deviation		0.000	0.010	0.003	0.067	8.0
	Maximum		0.002	0.025	0.009	0.170	18.5
	Minimum		0.002	0.000	0.003	0.030	3.0
	Median		0.002	0.013	0.007	0.088	7.0
R Spill	Average		0.008	0.016	0.008	0.196	10.6
	Count	0	6	7	6	7	6
	Standard deviation		0.007	0.007	0.005	0.296	6.8
	Maximum		0.021	0.025	0.013	0.705	19.0
	Minimum		0.004	0.005	0.001	0.000	0.5
	Median		0.005	0.015	0.009	0.030	12.8
Smith Spring	Average	5.10	0.063	0.095	0.333	1.145	15.3
	Count	6	21	1	21	1	21
	Standard deviation	5.50	0.143		0.620		18.6
	Maximum	14.13	0.660	0.095	2.560	1.145	88.0
	Minimum	0.64	0.000	0.095	0.000	1.145	0.0
	Median	2.61	0.011	0.095	0.040	1.145	8.7
Spring Hollow Hwy 39	Average	5.30	0.036	0.142	10.341	9.931	153.2
	Count	2	25	6	26	6	24
	Standard deviation	1.50	0.064	0.119	8.664	2.764	216.7
	Maximum	6.36	0.300	0.360	35.615	13.940	706.3
	Minimum	4.24	0.000	0.020	2.920	6.975	0.0
	Median	5.30	0.015	0.130	7.000	9.758	53.2
Sterling Wetland	Average	14.69	0.029		1.178		15.3
	Count	6	17	0	18	0	17
	Standard deviation	8.36	0.041		0.772		21.9
	Maximum	27.55	0.150		2.880		80.3
	Minimum	5.65	0.000		0.160		0.0
	Median	12.98	0.010		1.169		5.7

[1]statistics not calculable if no data (count=0); standard deviation not calculable with only one data point (count=1)

Contribution of nitrogen from those waterbodies whose flow is highly dependent on groundwater is not surprising. The Fort Hall area has been identified as having degraded ground water quality due to high nitrate levels (DEQ 2001a).

Other than Danielson Creek, Hazard Creek/Little Hole Draw, and Sunbeam Creek, it is unknown if pollutants in these unlisted waterbodies are affecting beneficial uses in the waterbodies themselves. Assessment of BURP data for Danielson Creek, Hazard Creek/Little Hole Draw, and Sunbeam Creek showed impairment of beneficial use support of coldwater aquatic life (Table 2-14).

Point sources

Data for point sources were available from Discharge Monitoring Reports (DMRs) for Aberdeen, Blackfoot, Firth and Shelley wastewater treatment plants (WWTP). No data were available for Crystal Springs Trout Farm. Discharges from the four WWTPs are low. Blackfoot discharge averaged 2.45 cfs, while Aberdeen, Firth, and Shelley all averaged less than 0.67 cfs (Table 2-18).

Wastewater treatment plants in Blackfoot, Firth, and Shelley all contribute directly to Snake River (Appendix D). The Aberdeen WWTP discharges into Hazard Creek/Little Hole Draw, which flows into American Falls Reservoir. Total phosphorus concentrations in the effluent of the four WWTPs ranged from 1.28 mg/L at Aberdeen to 3.91 mg/L at Blackfoot (Table 2-18). The majority of the total phosphorus discharged by the plants is in the form of orthophosphorus, which is the form most readily used by plants.

The form of nitrogen discharged into the receiving waterbodies varies by WWTP (Table 2-18). Most nitrogen discharged at Firth is in the form of ammonia while Blackfoot primarily discharges nitrate+nitrite. Aberdeen has a mix of both ammonia and nitrate+nitrite. Both nitrate+nitrite and ammonia are readily available for uptake by plants. Much of Shelley's effluent is in the form of organic nitrogen (total Kjeldahl nitrogen minus total ammonia represents the amount of organic nitrogen in the effluent), which is nitrogen tied up in plant or animal tissue.

Loading of total suspended solids does not appear to be significant. None of the four WWTPs discharged effluent at concentrations greater than 45 mg/L and concentrations at both Aberdeen and Blackfoot were less than 12 mg/L TSS (Table 2-18).

2.4 Data Gaps

Seldom is there enough data to confidently predict, without hesitation, exactly what is occurring in an ecological system. Invariably, there are certain areas where more data would be useful in order to make more accurate predictions of ecological ramifications. The most basic data gap is natural background levels for sediment and nutrients – they are unknown.

Table 2-18. Water quality data from wastewater treatment plants in American Falls Subbasin, January 2000 to September 2003 (from Discharge Monitoring Reports).

Parameter	Statistic	Wastewater treatment plant			
		Aberdeen	Blackfoot	Firth	Shelley
Flow (cfs)	Average	0.65	2.45	0.18	0.47
	Count	45	44	45	41
	Standard deviation	0.17	0.89	0.16	0.12
	Maximum	1.07	4.94	0.79	0.67
	Minimum	0.36	1.53	0.00	0.20
	Median	0.65	2.04	0.14	0.48
Total orthophosphorus (mg/L)	Average		3.63	1.91	1.43
	Count		30	6	11
	Standard deviation		1.47	0.36	0.59
	Maximum		8.07	2.40	2.45
	Minimum		0.20	1.28	0.14
	Median		3.53	1.91	1.51
Total phosphorus (mg/L)	Average	1.28	3.91	2.75	2.74
	Count	8	31	6	11
	Standard deviation	0.29	1.48	0.59	1.20
	Maximum	1.70	8.08	3.91	5.72
	Minimum	0.86	0.37	2.24	0.87
	Median	1.27	3.87	2.63	2.61
Total ammonia (mg/L)	Average	5.04		12.53	6.10
	Count	8		6	11
	Standard deviation	3.07		2.86	4.32
	Maximum	8.90		15.20	12.50
	Minimum	0.03		7.46	0.03
	Median	5.10		13.50	5.91
Total nitrate+nitrite (mg/L)	Average	3.79	18.60	0.09	0.55
	Count	8	31	6	11
	Standard deviation	2.67	6.23	0.12	0.51
	Maximum	8.60	31.30	0.33	1.60
	Minimum	0.87	6.63	0.02	0.03
	Median	3.17	17.80	0.05	0.49
Total Kjeldahl nitrogen (mg/L)	Average	5.79	4.53	16.68	14.84
	Count	8	31	6	11
	Standard deviation	3.23	6.41	2.36	3.90
	Maximum	9.10	30.30	19.80	21.80
	Minimum	1.30	0.05	13.90	7.28
	Median	7.40	2.48	16.80	15.30
Turbidity (NTU)	Average		5.30	25.35	31.10
	Count		31	2	2
	Standard deviation		3.93	5.16	5.80
	Maximum		20.10	29.00	35.20
	Minimum		0.00	21.70	27.00
	Median		4.66	25.35	31.10
Total suspended solids (mg/L)	Average	11.35	10.85	22.47	42.24
	Count	45	11	45	41
	Standard deviation	4.55	2.47	18.75	39.66
	Maximum	19	14	67	231
	Minimum	2.4	6.7	0.0	2.5
	Median	11.0	10.9	19.0	33.0

Much of the recent data in American Falls Subbasin has been amassed during low water years. Although impossible to collect for this TMDL, information from average and high water years would be helpful. Bedload sediment estimates from average to high water years would be beneficial for Snake River along with bedload information for the tributaries.

Key data gaps involve the reservoir. The past several years, during which much of the sampling has been done, have had below-normal precipitation. Data are needed from more average water years and in seasons with less reservoir elevation fluctuation. There are no data on phosphorus recycling. Even with a reduction of phosphorus loading from tributaries, phosphorus internal to the reservoir may delay the expected recovery process. Addition of more sampling sites would further define dissolved oxygen and temperature problems in the reservoir. Finally, to facilitate future reservoir modeling, data appropriate to a chosen model should be collected. At minimum, improved bathymetric information should be gathered.

Springs dot the reservoir landscape. No data are extant on the contribution of pollutants of many of these springs. This lack of data is especially true for those springs generally inundated by the reservoir.

More data from waterbodies on Fort Hall Indian Reservation are needed to accurately estimate loads (e.g., Ross Fork) and/or determine beneficial use support (i.e., Bannock Creek, Moonshine Creek and lower Rattlesnake Creek). The paucity of data (chemical, biological, physical) for Bannock Creek and its tributaries, both temporally and spatially, significantly impedes the ability to conduct a comprehensive water quality assessment of the designated uses in the watershed. The limited existing data also increases the level of uncertainty for watershed loading models used to support these TMDLs. Additional sampling is needed for Bannock Creek and its tributaries to establish a more definitive baseline for stream bank stability, and existing and desired sediment bedload. The Shoshone-Bannock Tribes have begun to address some of these data gaps through its water quality monitoring program.

Streamflow discharge data is also inadequate within the American Falls Subbasin. USGS streamflow exists for Bannock Creek; however, streamflow gages are not present on tributaries such as McTucker Creek, West Fork, Moonshine Creek, Rattlesnake Creek and Knox Creek.

Due to the limited number of bacteria sampling events, further bacteria sampling is necessary on Bannock Creek. Although the two available samples indicated elevated bacteria levels, a significant amount of *E. coli* data, collected in accordance with DEQ water quality standards, is necessary to verify contact recreation use attainment. Section 251 of DEQ surface water quality standards stipulates that the secondary contact recreation use assigned to Bannock Creek is assessed by using a geometric mean of 126 *E. coli* organisms per 100 ml based on a minimum of five samples taken every three to five days over a 30-day period.

Given the uncertainty of whether or not contact recreation use is impaired in Bannock Creek, DEQ and the Shoshone-Bannock Tribes are committed to conducting a coordinated sampling effort in 2004 to collect additional *E. coli* samples. An initial recommendation for an *E. coli* monitoring approach would entail the collection of a minimum of ten samples at each of three stations (one off-reservation, two on-reservation) located along Bannock Creek during June and August. DEQ and the Shoshone-Bannock Tribes will work together to prepare a quality assurance project plan (QAPP) that will more explicitly define the sampling approach and analytical protocols to be used, prior to initiating sampling.

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